Report No. CG-D-18-97

Fire Safety Analysis of the USCGC VINDICATOR (WMEC 3)

Chester M. Sprague, P.E.
Herbert Holmstedt
Betty Romberg

CompuCon
21808 East River Road
Grosse Ile, MI 48138

Brian L. Dolph

U.S. Coast Guard
Research & Development Center
1082 Shennecossett Road
Groton, CT 06340-6096

Final Report
December 1996

Prepared for:

U.S. Department of Transportation
United States Coast Guard
Systems, (G-S)
Washington, DC 20593-0001

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

The contents of this report reflect the views of the Coast Guard Research & Development Center. This report does not constitute a standard, specification, or regulation.

G.T. Gunther
Commanding Officer
United States Coast Guard
Research & Development Center
1082 Shennecossett Road
Groton, CT 06340–6096

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
CG-D-18-97		

4. Title and Subtitle

Fire Safety Analysis of the USCGC VINDICATOR (WMEC 3)

5. Report Date
December 1996

6. Performing Organization Code
3309.026

7. Author(s)

Chester M. Sprague, P.E., Herbert Holmstedt, Betty Romberg, Brian L. Dolph

8. Performing Organization Report No.

R&DC 36/96

9. Performing Organization Name and Address

CompuCon
21808 East River Road
Grosse Ile, MI 48138

U.S. Coast Guard
Research and Development Center
Groton, CT 06340-6096

10. Work Unit No. (TRAIS)
~~SHRD Report # 109~~

11. Contract or Grant No.

DTCG39-94-F-E00421

12. Sponsoring Agency Name and Address

U.S. Department of Transportation
United States Coast Guard
Systems, (G-S)
Washington, DC 20593-0001

U.S. Coast Guard
Research and Development Center
1082 Shennecossett Road
Groton, CT 06340-6096

13. Type of Report and Period Covered

Final Report

14. Sponsoring Agency Code

Commandant (G-SEN)

15. Supplementary Notes
The Coast Guard technical contact and COTR is Brian Dolph of the U.S. Coast Guard Research and Development Center. The Headquarters Project Officer is CDR Greg Kirkbride of the USCG Engineering Logistic Center.

16. Abstract

The Ship Fire Safety Engineering Methodology (SFSEM) was utilized as an analytical tool to conduct a comprehensive analysis of the baseline fire safety of the VINDICATOR compared to pre-established fire safety objectives. Results indicate that all compartments in the VINDICATOR exceed the fire safety objectives by a substantial margin with their existing passive and active fire protection features in effect. Various alternatives to the proposed design were studied to gain insight into the relative effect of certain design features on the baseline fire safety. The SFSEM has been shown to be a valuable tool to evaluate heretofore incomparable entities such as a better barrier or a more effective firefighting system and quantify their effectiveness. The VINDICATOR is an ex-USNS Ocean Surveillance Ship (T-AGOS) conversion to a Coast Guard Medium Endurance Cutter (WMEC).

In addition, this report includes a detailed fire protection doctrine tailored for VINDICATOR. This doctrine provides: information pertinent to fire science in part A, firefighting policy and guidance provided by the Commandant, U.S. Coast Guard for large cutters in part B, and procedures for combating all classes of fires in all conceivable compartments in part C.

17. Key Words

Fire Protection, Small Cutter, Fire Doctrine, Fire Safety, Ship Fire, Engineering Methodology, Cutter, Coast Guard, Navy conversion, Medium Endurance Cutter, T-AGOS

18. Distribution Statement

This document is available to the U.S. public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. SECURITY CLASSIF. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED		

Form DOT F 1700.7 (8/72) Reproduction of form and completed page is authorized

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (WEIGHT)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (EXACT)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly).

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (WEIGHT)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	0.125	cups	c
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (EXACT)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

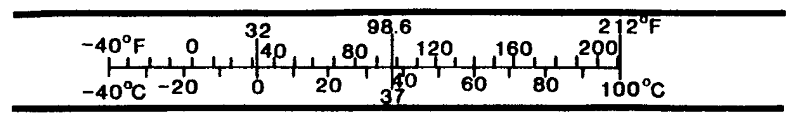

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND TERMS

Active Fire Protection - Fire protection features designed to limit the flame movement by automatic detection, fixed fire extinguishing systems, and manual suppression systems or equipment. Examples of active fire protection features are: automatic sprinkler systems, fire extinguishers, and trained firefighting teams. See "Passive Fire Protection".

A value - The probability that an automated fixed fire protection system installed in a compartment will successfully extinguish the fire before FRI occurs. See "I value" and "M Value".

AFFF - Aqueous Film Forming Foam. A firefighting agent particularly effective against class B fires.

Alpha - The fire growth coefficient in the pre-FRI heat release rate algorithm. Generally, alpha is set to .001 for slow growth, .01 for moderate growth, .1 for fast growth and 1.0 for ultra-fast fire growth. Engineering judgment is used to select alpha and intermediate values are frequently used. See "Pre-FRI Heat Release Rate".

Alternative Data Set - Data sets identified as "Alternative" have had the baseline input values to SAFE adjusted as necessary to reflect the impact of the proposed alterations or modifications which affect the ships' fire safety system. See "Baseline Data Set".

AMTBL - Acceptable Mean Time Between Losses. See "FTA."

AutoCAD - Commercially available software used to display the plan views of a ship's compartmentation on each deck level.

Baseline Data Set - Data sets identified as "Baseline" utilize input values to the SAFE program based on the physical condition of the ship found during the ship visit and are not influenced by any modifications or alterations which may be proposed as a result of an analysis. See "Alternative Data Set".

Beyler/Peatross Algorithm - The algorithm used in SAFE to calculate FRI-time for compartment fires. Primary variables include heat release rate, heat loss through the boundaries and the incoming air. See "FRI-Time".

CBO - Compartment Burnout - The point in the fire growth curve where exhaustion of all fuel due to pyrolysis occurs.

Class A Fire - A fire involving cellulosic type products (wood, cotton, paper, etc.) that produce ash as a combustion product. Water is the primary firefighting agent and extinguishes the fire by cooling the fuel below the ignition point. See "Class B Fire" and "Class C Fire".

Class B Fire - A fire involving flammable liquids (fuel oil, lube oil, gasoline, etc.) that burn vigorously without producing ash. AFFF is the primary firefighting agent and extinguishes the fire by smothering the fire with a thick layer of foam that floats on the surface of the fuel. See "Class A Fire" and "Class C Fire".

Class C Fire - An electrical fire that frequently involves class A or B fires as well. Electrical fires are usually extinguished when the electrical power to the affected equipment is secured, however the associated class A or B fire may continue to burn. CO_2 is the primary firefighting agent and extinguishes the fire by smothering the fire without damaging electrical or electronic components. See "Class A Fire" and "Class B Fire".

CO_2 - Carbon Dioxide. A firefighting agent particularly effective against class C fires.

COR - Circular of Requirements. A document that describes the specifications for a proposed ship design.

CSRLI - Cutter Standard Repair Locker Inventory. A U.S. Coast Guard Commandant Instruction that specifies the allowance for damage control equipment on board a Cutter.

CUI - Compartment Use Indicator - An abbreviated designation for a compartment selected from a list provided in SAFE used to define the type or function of the compartment and establish default values for various fire parameters.

D-Adjust - A user defined parameter that can range from 0 to -99% to modify the Dbar values for a barrier. Usually used to account for deterioration of the barrier. See "Dbar".

Data Set - A data set describes those characteristics of a ship which affect its performance as a fire safety system. It includes information describing particular aspects of each compartment such as geometry, construction, fuel type and load, automatic detection and monitoring systems, ventilation and fire protection systems. See "Alternative Data Set" and "Baseline Data Set".

Dbar - The probability that a barrier will not fail due to durability or massive failure.

DCA - Damage Control Assistant. A designated ship's officer who is responsible for the damage control organization.

DOS - Disk Operating System. The operating system used on some personal computers.

EB - Established Burning - The point in the fire growth curve between ignition and FRI when the fire starts to grow exponentially with respect to time. In SAFE, it is assumed that this exponential growth varies with the 2nd power of time. EB is usually considered equivalent to a flame 10" high. EB also signifies the demarcation between fire prevention and the beginning of the ship's response to the fire.

EEBD - Emergency Escape Breathing Device. This self contained device provides 15 minutes of oxygen for the purpose of escaping from a fire.

FAL - Frequency of Acceptable Loss. The frequency with which a compartment can sustain a given Magnitude of Acceptable Loss (MAL). The FAL and MAL together establish the FSOs for a given compartment. See "MAL" and "FSOs".

FFS - Fire Free State. The status of a compartment relative to fire before ignition has occurred.

Fire Growth Model - One of 16 models of fire growth defined in SAFE that describe the characteristics of the fuel load in a compartment. The fire growth model determines the fire growth coefficient, alpha, and the maximum heat release rate, Qmax. See "Alpha" and "Qmax".

Fire Safety System - A term used to address the overall performance of a ship as it relates to fire safety. It considers the ship as a whole and accounts for such things as compartment geometry, construction, fuel type and load, automatic detection and monitoring systems, ventilation and fire protection systems.

FLLR - Flammable Liquid Line Rupture. A scenario used in SAFE to model a class B spray fire. The key user defined variables include the amount of fuel due to the rupture that is added to the compartment's fuel load, the room of origin and its associated FRI time and I value.

Frequency of EB - A frequency based on historic fire casualty data compiled from data provided by the U.S. Naval Safety Center and the Coast Guard's MISREP mishap reporting system.

FRI - Full Room Involvement - The point in the fire growth curve when the temperature in a compartment has increased 500C above ambient. FRI conditions include surface burning of all combustibles and survival for unprotected personnel is not possible.

FRI Time - The elapsed time (in minutes) from EB to FRI calculated in SAFE using the Beyler-Peatross algorithm.

FSOs - Fire Safety Objectives - Performance standard, ideally established by cognizant authorities, for a compartment accounting for mission protection, property protection and life safety. The SFSEM is designed to analyze, quantify and compare the ship's performance as a fire safety system to achieve the established FSOs on a compartment basis. The FAL and MAL together establish the FSOs for a given compartment. See "FAL" and "MAL".

FTA - Fault Tree Analysis. An approach for establishing FSOs that takes into account the effect losing one compartment has on another; useful for situations where equipment redundancies require multiple simultaneous losses before the ship's mission is affected.

FY - Fiscal Year (For example, FY94 is Oct. 1, 1993 to Sept. 30, 1994).

G-ENE - Naval Engineering Branch in the Engineering Division, USCG Headquarters

G-KSE - Safety Branch in the Health and Safety Division, USCG Headquarters

Halon - Halogenated Hydrocarbon. A firefighting agent particularly effective against all classes of fires, but presently banned from further production in accordance with the Montreal Protocol due to its atmospheric ozone-depleting characteristics.

HVAC - Heating Ventilation and Air Conditioning system. The system on board a ship which supplies and/or exhausts warm and/or cool conditioned air to interior compartments.

Ignition - Point in the fire growth curve that denotes the beginning of pyrolysis of combustible fuel.

In-Storage Scenario - A scenario used in SAFE to model the decommissioned, unmanned status of a ship in long term storage at a shipyard. The key user defined variables include Frequency of EB, A values and M values for each compartment.

I value - The probability that the fire will self-extinguish at some point between EB and FRI.

L curve - A graph which plots the cumulative probability of limiting the flame on the Y axis against time or some other suitable parameter on the X axis such as the number of rooms in a fire path. Convention calls for plotting 0 probability of limiting the flame at the top of the Y axis and 100% probability of limiting the flame on the X axis.

MAL - Magnitude of Acceptable Loss - The severity of damage that can be tolerated in a compartment. FAL and MAL together establish the FSOs for a given compartment. See "FAL" and "FSOs".

M value - The probability that manual firefighting efforts will successfully extinguish the fire before FRI occurs.

NFTI - Naval Firefighting Thermal Imager. A hand held device used to locate the source of flames in a compartment by sensing the temperature of the fire.

Non-Standard Scenario - Similar in all respects to a Standard Scenario except that it considers reduced levels of available fire protection systems.

NSTM - Naval Ship's Technical Manual. A set of regulations and guidelines issued by the U.S. Navy and frequently cited in U.S. Coast Guard regulations.

NWP - Naval Warfare Publication. A U.S. Navy publication.

OBA - Oxygen Breathing Apparatus. A self contained device that supplies oxygen to facilitate firefighting in untenable atmospheres.

One-Shot Halon System - A total flooding system with the capability to completely flood the protected space one time with the required concentration level of Halon 1301.

P-250 - A portable gasoline-powered pump used for firefighting and dewatering.

Passive Fire Protection - Fire protection features designed to limit the flame movement by their presence alone. Barriers are the best example of passive fire protection, intumescent coatings, fire doors, fuel load distribution, and insulation of hot surfaces are other examples. See "Active Fire Protection".

PIR - Polar Icebreaker Replacement - Design for the replacement of the Coast Guard's Polar Icebreaker class. The PIR project in 1987 was the first time the SFSEM was utilized to analyze the fire safety performance of a Coast Guard Cutter.

PKP - Potassium bicarbonate. A dry chemical firefighting agent frequently used in portable fire extinguishers. The only authorized dry chemical portable fire extinguisher permitted on board Coast Guard Cutters.

PMTBL - Predicted Mean Time Between Losses. See "FTA."

Post-FRI Heat Release Rate - A calculated rate of heat released from the burning fuel in a compartment fire which has achieved full room involvement. In SAFE, this value is calculated using the ventilation factor, $A^* H^{0.5}$, which takes into account the height and area of the ventilation opening. The numerical coefficient used (1500) assumes stoichiometric burning conditions.

Pre-FRI Heat Release Rate - A calculated rate of heat released from the burning fuel in a compartment fire before the compartment has achieved full room involvement. In SAFE, the primary variables in this calculation include the fire growth coefficient, alpha, and time squared.

Qmax - The maximum permissible value of the heat release rate. Qmax is a function of the fire growth model. See "Fire Growth Model".

RAM - Random Access Memory

RLF - Relative Loss Factor - RLFs are calculated in SAFE as a means of assessing whether a target compartment or set meets FSOs. A Relative Loss Factor > 1 indicates that a compartment has failed to meet its FSOs. This factor is determined by multiplying the target's relative FAL given fire free state (calculated during a given run of SAFE) by the assigned FAL. A target is considered lost if its level of fire involvement in a given path exceeds the level specified by its MAL rating.

SAFE - Ship Applied Fire Engineering - The computerized implementation of the SFSEM.

SATCOM - Satellite Communication

SCBA - Self Contained Breathing Apparatus

Scenario - A situation defined by the user before executing a SAFE probabilistic model run. Such parameters as run time, ship location, material condition of readiness and firefighting configuration are specified.

SCFP - Small Cutter Fire Protection. Project sponsored by Commandant (G-ENE) to analyze fire safety on cutters less than 180' in length.

SFSEM - The Ship Fire Safety Engineering Methodology. A probabilistic-based risk analysis methodology used to analyze all aspects of the ship's performance in response to a fire compared to pre-established FSOs.

SHIPALT - Ship Alteration. A document that describes an authorized change to the configuration, compartmentation, or other major alteration to a ship. The purpose of SHIPALTS is to standardize all ships in a class.

SOLAS - Safety of Life at Sea. An international convention prompted by the Titanic disaster and amended several times since that time that establishes international regulations for building ships to ensure the safety of passengers.

Standard Scenario - Scenarios used to fully define a ship's response to fire under the different operating conditions experienced by the vessel with full fire protection capabilities available.

Stoichiometric - A term that describes ideal burning which assumes there is sufficient oxygen to ensure 100% combustion of available fuel.

SURTASS - Designation for equipment to tow a neutrally buoyant passive surveillance sonar array.

T-Adjust - A value that can range from 0 to -99% that is applied to the Tbar value of a specified barrier to account for deterioration.

T-AGOS - Designation for a class of Auxiliary General Ocean Surveillance Ships operated by the Military Sealift Command for the U. S. Navy.

Tbar - The probability that a barrier will not fail due to thermal or hot spot failure.

TBD - To Be Determined. A term often used to describe information not presently available.

Two-Shot Halon System - A total flooding system with the capability to completely flood the protected space two times with the required concentration level of Halon 1301. This system is designed such that each shot of Halon is released from a different location in the vessel.

USCGC - United States Coast Guard Cutter

Ventilation Factor - A factor, $A*H^{0.5}$, that describes the primary variables in the post-FRI heat release rate calculation in SAFE. These variables are the area and height of the ventilation opening(s) in a compartment.

WLM (R) - River Buoy Tender. The "R" indicates that this is a replacement for an existing class of buoy tender.

WMEC - Medium Endurance Cutter

XRAY, YOKE and ZEBRA - Material Conditions of Readiness. Successively increasing readiness conditions for controlling damage. At each level, additional access closures, valves and fittings are required to be closed to limit fire and flooding.

YARD - The U.S. Coast Guard YARD located in Curtis Bay, MD.

Zero-Strength Barrier - An imaginary boundary used to model extremely long passageways and multiple deck compartments. The barrier is presumed to have no thermal resistance.

Acknowledgments

The authors are indebted to the numerous people who generously contributed their time and expertise in conducting the fire safety analysis of the USCGC VINDICATOR (WMEC 3). Mrs. Bettie Proctor worked long hours using AutoCAD to produce the ship's drawings and ship visit forms. In addition she worked diligently to support the preparation of the final report by creating and importing the numerous tables and figures. Mrs. Doris Rich provided excellent support with the database during the fire safety analysis phase of the project. Mr. Lance Ryley ably assisted in conducting the research into the historical fire safety records of similar sized vessels in the Coast Guard fleet. LCDR Eric Linton, the T-AGOS/WMEC Conversion Project Officer at the Coast Guard YARD, was extremely cooperative and provided information that improved the accuracy and validity of the analysis. The professional and dedicated contributions provided by these individuals and the entire project team is gratefully acknowledged and truly appreciated.

1. INTRODUCTION

1.1. BACKGROUND

In 1994 the Coast Guard commenced a project to convert U.S. Navy T-AGOS class ocean surveillance vessels for use as Medium Endurance Cutters in the U.S. Coast Guard fleet. The conversion project includes compartmentation and equipment changes required to make the ships suitable for conducting Coast Guard missions such as Enforcement of Laws and Treaties with a Coast Guard crew. The specifications and design drawings were to be developed by the Coast Guard YARD who would also provide the labor and materials required to perform the conversion.

As a consequence of the Coast Guard's intentions to minimally man the ship, a project to thoroughly evaluate the fire safety of the vessel was desirable. The ship, as received from the Navy, has marine plywood joiner paneling on the main deck, 01 and 02 decks. In addition, prefabricated fiberglass toilet/shower units are installed in the sanitary spaces serving officer and crew staterooms. The damage control fittings such as watertight doors are not currently classified for damage control material conditions of readiness nor are the compartments numbered in accordance with the guidance provided in the Naval Ships' Technical Manual [1]. Interim results were desirable early in the project due to the possibility that long lead time materials may be required to implement some of the recommendations of the fire safety study.

The following sections describe in more detail the T-AGOS/WMEC conversion project as well as the Small Cutter Fire Protection project which established the utility of the methodology to be used in the analysis. In addition the objectives, scope and technical approach used in the fire safety analysis project are discussed.

1.1.1. T-AGOS / WMEC CONVERSION PROJECT

The U.S. Navy class of Auxiliary General Ocean Surveillance Ships (T-AGOS) consists of 18 vessels built during the period 1982 through 1988. The primary feature of the T-AGOS ships is the SURTASS equipment designed to tow a 6000 ft., neutrally buoyant, passive surveillance sonar array. Information from the towed array is relayed via satellite communication (SATCOM) link to shore. Most of the compartmentation aft of the stacks on the main deck and above was dedicated to the SURTASS and top secret communications equipment associated with the ship's mission. Typical patrols were 60-90 days with the ship towing the array at three knots. The maximum speed of the vessel is 11 knots. The ships were operated and maintained by a civilian contractor for the Military Sealift Command. The crew thus consisted of 21 civilians, and a contingent of 9-12 Navy/Marine personnel.

The Coast Guard needed additional platforms to cope with the massive migration of Cuban and Haitian aliens in the summer of 1994. Therefore the decision was made to convert at least one and possibly as many as six T-AGOS ships for service in the Coast Guard as Medium Endurance Cutters. The conversion was planned for accomplishment in the Coast Guard YARD; they have the capability to develop the detailed conversion drawings and the flexibility to adapt to rapidly changing guidance provided by Coast Guard Headquarters during the project.

The VINDICATOR was the first T-AGOS class ship to arrive at the YARD for conversion. The YARD discovered several features that concerned them because they potentially involved materials which require a lengthy procurement process. These features included:

- marine plywood joiner paneling and celotex dropped ceilings installed throughout the Main Deck, 01 Deck and 02 Deck. The ceilings separate large utility void spaces from the staterooms, offices, etc. on these decks. Normally the joiner bulkheads in these compartments are carried to the deck above to limit the spread of smoke and flame; however, on this ship the joiner panels are carried only to the height of the dropped ceiling.
- fiberglass toilet/shower units installed in each pair of staterooms. These units are one piece drop-in type solid fiberglass construction. The plywood joiner panels are installed on the stateroom side. Fiberglass typically produces large quantities of dense black smoke and toxic gases if involved in a fire.

Due to the YARD's need to start the procurement process in a timely manner, it was agreed that the results of the preliminary baseline fire safety analysis would be provided when completed as opposed to waiting until the final report was delivered. In addition, it was agreed that the interim results would include a listing of compartment identification numbers as well as the appropriate damage control material condition of readiness rating for all doors in accordance with guidance provided in the Naval Ships' Technical Manual. [1]

The PERSISTENT was the second T-AGOS class ship to arrive at the YARD. Shortly after arrival and before any conversion work began, a fire started and extinguished itself in the Fan Room, 1-34-2-Q. Apparently, combustible materials stored on top of the preheater in the ventilation ductwork ignited when the preheater automatically energized due to cold temperatures. The fire damage was discovered by the roving watchstander well after the fire had extinguished itself. Consequently, the YARD rigged temporary smoke detectors in both ships in the Main Deck, 01 Deck and 02 Deck Passageways. These additional detectors were wired to the fire detection panel in the Pilot House which is remotely monitored ashore.

Subsequent to the fire safety analysis, but prior to completion of the final report, the conversion project was suspended by the Coast Guard due to budget constraints. The decision was made, however, to complete the final report to preserve the results of the analysis in the event the conversion project is reactivated in the future. Since the VINDICATOR and the PERSISTENT will remain at the Coast Guard YARD in storage, it is appropriate to consider the fire safety of the vessels in their present configuration during the protracted time they may be in the YARD.

1.1.2. SMALL CUTTER FIRESAFETY PROJECT

The Small Cutter Firesafety Project (SCFP) was initiated to examine all aspects of fire protection in all classes of Coast Guard Cutters less than 180 feet in length. The original scope of the SCFP included nine classes of small Coast Guard Cutters including most of the Patrol Boats, Tugboats and Construction/River Buoy Tenders in the Coast Guard fleet. The 175 ft Replacement Coastal Buoy Tender (WLM (R)) was included in the scope of this project after the final report on the nine cutters was completed. The primary objectives of the SCFP included analyzing the fire safety of the ten cutter classes and recommending improvements where needed. The deliverables in the project included interim and final technical reports including a fire

protection doctrine tailored to suit each class of cutter studied. The technical approach specified the use of the Ship Fire Safety Engineering Methodology (SFSEM) as the analytical tool to evaluate the fire safety of the cutters studied.

The SFSEM is a probabilistic-based risk analysis methodology which provides an integrated framework to account for all relevant aspects of shipboard fire protection. The Theoretical Basis of the SFSEM is documented and available in the Marine Fire and Safety Research Branch Library at the U.S. Coast Guard Research and Development Center.[2] The SFSEM is designed to evaluate a ship's performance compared to pre-established fire safety objectives (FSOs). This permits identifying over-protection as well as under-protection. The methodology quantifies the contribution of passive and active fire protection systems; thus, it provides a means for analyzing and comparing alternatives to improve the overall fire protection on the cutter. It also provides a means of evaluating the fire safety if certain fire protection features are hypothetically removed to eliminate over-protection. As documented in the final technical reports for the SCFP, the utility of the SFSEM to analyze existing and proposed ships, identify problem compartments which fail to meet FSOs, and analyze the effectiveness of hypothetical alternatives to correct the problems was clearly demonstrated. [3, 4]

1.2. SCOPE

The scope of this project is limited to analyzing the fire safety of the T-AGOS class ships, as configured for service in the Coast Guard fleet as a Medium Endurance Cutter. The VINDICATOR was studied as the representative of the class of T-AGOS ships. The SFSEM was specified to be used as the analytical tool to evaluate the fire safety of the vessel using a technical approach similar to that successfully employed in the SCFP. The existing fire doctrine for the VINDICATOR consists of a document that describes the firefighting procedures for combating a class B fire in the main machinery spaces. The scope of this project included a task to revise the existing fire doctrine taking into account the results of the fire safety analysis conducted in this project. Thus, a complete fire protection doctrine similar in format to the doctrines developed for the ten classes of small cutters in the SCFP was developed. In addition, the fire safety of the VINDICATOR and PERSISTENT was studied considering the specific conditions that will exist on these two ships during the period they will be in long term storage at the Coast Guard YARD.

1.3. OBJECTIVES

Two major objectives were established for this project. The first and most important objective was to thoroughly evaluate the fire safety design of the CGC VINDICATOR configured as a Medium Endurance Cutter. "Fire safety design" in this context includes the proposed compartmentation, construction materials, fire protection systems, firefighting equipment, procedures and tactics and any other aspect of the proposed design after conversion that pertains to fire safety. Since the design of the ship is subject to constant improvement, this analysis was based on information available to the USCG Research and Development Center in October, 1994 concerning the proposed design of the converted ship. This information was supplemented by a visit to the Coast Guard YARD, Curtis Bay, MD where the VINDICATOR is undergoing conversion. The ship was to be studied in its normal operating configuration, in port and at sea, with a full complement of outfit and crew. It was assumed that the ship would be initially undamaged and not be subject to fires inflicted by enemy action or arson. Compartments which

fail to meet pre-established FSOs were to be thoroughly studied to determine reasons for the problem, including an analysis of all the fire paths that contributed to the failure of the compartment to meet their FSOs. Hypothetical alternatives to improve the fire safety of any problem compartments were to be identified, and a cost benefit analysis was to be conducted to form the basis for recommendations to Coast Guard Headquarters. The Coast Guard could then consider the costs that would be incurred in issuing an engineering change proposal as opposed to retrofitting the delivered ships using the SHIPALT process. In the event that the baseline fire safety levels met the fire safety objectives by a substantial margin, the scope of this project permitted detailed study of certain features that directly pertain to fire safety. For example, the fiberglass shower units are of particular concern due to their propensity to produce smoke and toxic gases in a fire, and the total flooding Halon fire protection systems are known to cause environmental damage if discharged.

The second objective was to develop a tailored fire protection doctrine for the VINDICATOR. As a result of the work done in the SCFP, the fire protection doctrine for Coast Guard Cutters has been significantly expanded in scope and reformatted into three parts. The doctrine describes the principles of fire science in Part A, policies concerning firefighting promulgated by the Coast Guard and other authorities in Part B, and procedures and tactics for combating fires in Part C. Since Part A of the fire protection doctrine was developed as part of the SCFP and applies to all cutters, only Parts B and C require development as part of this project. The entire fire protection doctrine is included in Appendix D of this report for the sake of completeness. The doctrine specifies procedures for combating class A, B, and C fires in port and at sea in all types of compartments in the cutter. The scenarios are limited to those that are reasonable to expect, for example a class A fire in the Berthing Area, a class B fire in the Engine Room, and a class C fire in the Communications Room. Only equipment and procedures, authorized for the VINDICATOR and in consonance with published Commandant policy in the Naval Engineers Manual (Commandant Instruction M9000.6B) and other official documents such as NSTM, Chapters 555 and 079 are incorporated in the new doctrine. [1, 5, 6]

1.4. TECHNICAL APPROACH

This project is organized into four phases:

- Conduct background research
- Perform fire safety analysis
- Develop fire protection doctrine
- Prepare final report

The background research phase includes a review of the drawings and specifications that describe the details of the planned conversion to a Coast Guard Medium Endurance Cutter (WMEC). This phase also includes modeling the compartmentation in AutoCAD so that the necessary ship visit forms can be produced. A trip to the Coast Guard YARD was required to collect detailed information necessary to perform a fire safety analysis using the SFSEM. The fire safety analysis phase includes a thorough review of the baseline fire safety levels of the ship on a compartment basis as well as the study of alternative enhancements to improve the fire safety of any compartments which fail to meet their FSOs or particular ship design features that pertain to fire safety. The fire protection doctrine phase involves the development of Part B which describes

the policies pertaining to firefighting on large cutters in the Coast Guard. In addition, the procedures and tactics for combating all classes of fires in all types of compartments are developed in this phase. Finally, the results of the study are documented in this final report and the new doctrine is included as an appendix to the report.

The technical approach used to perform the fire safety analysis is similar to that used in the SCFP. Briefly, this approach called for performing a baseline fire safety analysis on the baseline data set using the individual target option in SAFE to determine baseline fire safety levels of every compartment compared to pre-established fire safety objectives. The technical approach used in the SCFP was altered for the VINDICATOR due to its much larger size and many more compartments compared to small cutters. The changes included using default values for fuel loads, FSOs and probabilities of flame limitation instead of individual calculations for each compartment. More significantly the individual target option, used extensively in the SCFP, was augmented by the barrier option due to the discovery that the target option provided conservative but imprecise results. Section 3.2 provides additional details concerning the fire safety analysis phase of this project.

The technical approach used to develop the fire protection doctrine for the VINDICATOR included analyzing the existing main space fire protection doctrine. This provided a good starting point for developing procedures to combat class B fires in the machinery spaces. The new doctrine was developed taking into account the feedback from Coast Guard Headquarters in the SCFP. The new doctrine also incorporates procedures for class A and class C fires as well. Information from a variety of sources was utilized to develop these procedures and tactics including:

- Naval Ships Technical Manual, chapters 555 and 079, vols. 1-4 [1, 6]
- Surface Ship Survivability Manual, NWP 62-1 (Rev C) [7]
- Cutter Casualty Control Manuals [8]
- Vessel Safety Manual [9]
- Marine Fire Prevention, Firefighting, and Fire Safety [10]
- Various articles in the literature

Each cutter in the class will have to tailor part C of the new doctrine to account for any differences between themselves and the VINDICATOR. Moreover, this doctrine only applies to T-AGOS class ships which have been converted to WMEC and are operated with a Coast Guard crew. Differences may exist due to uncompleted (or unauthorized) SHIPALTS and other changes pertaining to the fire safety design of other ships in the class. Crew members, who have been transferred to VINDICATOR from other small cutters, will have to study both Parts B and Part C of the doctrine for their new ship. In addition, damage control personnel or others generally familiar with fire science will not have to study Part A. Maintenance of the new fire protection doctrine is simplified. The Commandant is the appropriate authority responsible for updating and maintaining Parts A and B of the doctrine. The individual cutter is responsible for tailoring, then maintaining, Part C in accordance with the guidance provided in Parts A and B.

Section 2 of this report provides a detailed explanation of the SFSEM and its implementing computer programs, SAFE. An understanding of the SFSEM/SAFE is essential to comprehending the results of the Fire Safety Analysis discussed in section 3. Section 4 provides an explanation and background information concerning the Fire Protection Doctrine developed

for the VINDICATOR. Section 5 provides the conclusions and recommendations that were developed as a result of the preliminary and detailed fire safety analyses accomplished in this project. Appendix A includes a tabulation of all compartments in the VINDICATOR as well as profile drawings and plan views of all decks. In addition, the listing of compartment numbers and damage control classifications for all doors, scuttles and hatches delivered with the preliminary results is included in Appendix A. Appendix B is the documentation of all baseline input data collected during the ship visit and determined from a review of conversion specifications and drawings. Appendix C is a summary of the results of running SAFE on the baseline data set and the analysis of alternatives. Appendix D includes the complete fire protection doctrine developed for VINDICATOR.

2. SHIP FIRE SAFETY ENGINEERING METHODOLOGY

2.1. INTRODUCTION

The overall fire safety of a ship is not obvious. It is dependent upon many factors, including the vast number of fire scenarios that are possible. Furthermore, a ship is actually a fire safety system, because it demonstrates performance in all phases of the life cycle of fire from prevention through detection, containment, and extinguishment. To perform a fire safety analysis, a means is required to evaluate a ship's response to fires as a fire safety system. The analysis should be able to show how the fire safety system would perform if various alternatives such as better fire boundaries, improved fire detection, or more effective manual firefighting techniques were used. In other words, a means of modeling fires on ships is required which accounts for all the relevant aspects of fire and firefighting in an integrated framework. The Ship Fire Safety Engineering Methodology (SFSEM) provides this integrated framework. The following sections furnish an overview of some of the more important features of SFSEM and its implementing computer program, Ship Applied Fire Engineering (SAFE). The SFSEM and SAFE are discussed in detail in documentation available at the Coast Guard Research and Development Center in the Marine Fire and Safety Research Branch Library. [2, 11]

2.2. SFSEM OVERVIEW

2.2.1. SFSEM FRAMEWORK

The ship, as a fire safety system, refers to the performance of a ship in all relevant aspects of fire from preventing fires in the first place, to responding to the flames and smoke produced from fires. In addition, the ability of passengers and crew to escape from a fire and the inherent ability of the ship's structure to withstand the fire's assault are also relevant considerations of a ship as a fire safety system. The SFSEM is designed to provide a comprehensive analysis of all aspects of the ship's performance as a fire safety system. It is designed in a modular fashion so that each of these considerations can be studied in isolation and so that the completed modules of the methodology can serve a useful purpose while others are being developed. The complete SFSEM consists of six modules categorized as shown in Table 2.1.

Table 2.1 SFSEM Modules

Performance Identification Module
Establish Fire Safety Objectives (FSOs)
Engineering Analysis Modules
Prevent Established Burning (EB)
Flame Movement
Smoke Movement
People Movement
Structural Frame

The Establish FSOs, Prevent EB and Flame Movement modules are incorporated in the current version of SFSEM [2]; the other three modules are under development at the present time or will be developed in the future. The following sections provide an overview of these six individual modules.

2.2.2. ESTABLISH FIRE SAFETY OBJECTIVES

In order to analyze the performance of a ship as a fire safety system, there must be acceptable performance standards or criteria established by cognizant authorities. These criteria are referred to as Fire Safety Objectives (FSOs). Ideally, FSOs are established by cognizant authorities taking into consideration life safety, property protection and mission impairment. Cognizant authorities in the Coast Guard are the appropriate program and support managers in Coast Guard Headquarters. In the absence of such input, FSOs were established for the ten classes of cutters analyzed previously in the SCFP on a compartment by compartment basis using the engineering judgment of the engineers/analysts in accordance with the guidance provided in the Theoretical Basis of the SFSEM. [2] **Approval of the final fire safety analysis report by cognizant authorities implies acceptance of these FSOs.**

FSOs are designed to establish the performance standard for a fire safety system taking into account all aspects of fire including flame movement, smoke movement, people movement (egress for the occupants), and the ability of the structure to withstand the fire's assault. In the SFSEM, smoke movement, people movement, and structural analysis modules are not yet fully developed, therefore the FSOs are presently established considering flame movement only.

The process for assigning FSOs is a complex and contentious issue. It includes not only the identification of cognizant authorities but also ensuring that they are trained and knowledgeable to assign FSOs. In addition, it involves integrating multiple considerations for flame movement. In the future the SFSEM will include the ability to analyze smoke movement which will further complicate the process. Moreover, there has been some discussion that assigning FSOs on a compartment basis may not be appropriate; assigning FSOs at the ship or even ship class level may be more appropriate. Finally FSOs presently do not take into account the effect that losing one compartment has on another. For example ships with redundant engine rooms would require the loss of both engine rooms simultaneously before the ship's mission would have to be aborted. Consequently, the subject and methodology of establishing FSOs is under continuing study.

FSOs are established for each compartment in the cutter that may be analyzed by SAFE. Currently, magazines, flammable liquid tanks, and helicopter hangars are not analyzed due to the inability of SAFE to deal with explosion hazards. All other compartments are rated for both Magnitude of Acceptable Loss (MAL) and Frequency of Acceptable Loss (FAL). The MAL is permitted to be one of the following four ratings:

1. Established Burning (EB) is not acceptable
2. EB is acceptable but Full Room Involvement (FRI) is not
3. FRI is acceptable but Compartment Burnout (CBO) is not
4. CBO is acceptable

A compartment's MAL is assigned a rating of 1-4 depending on its essentiality to the ship's missions, life safety considerations, and potential cost of property damage. For the Flame

Movement Module, mission is the primary concern. Compartments whose total loss (CBO) would not significantly affect the ship's mission are normally assigned a rating of 4. For example, most sanitary spaces, gear lockers, passageways, voids, water tanks, ladders, cofferdams, and certain storerooms, if totally lost, would not prevent the ship from performing its mission. Note, a compartment may contain a significant fuel load and contribute materially to the spread of a fire, but if its loss does not affect the ship's mission, it receives a rating of 4. At the other extreme, flammable materials storage lockers, paint lockers, and other compartments containing extremely flammable materials may result in mission loss if they even reach EB. These spaces are assigned a rating of 1.

The balance of the compartments are normally assigned a rating of 2 or 3. In general, if the compartment contains equipment vital to the ship's mission, and if its loss would likely result in the ship aborting its patrol and returning to homeport for repairs, it would be assigned a 2. On the other hand, if the compartment's loss would degrade, but not prevent, the ship's ability to perform its mission, it would receive a 3 rating. Examples of compartments typically rated 2 are the Engine Room, Bridge, and Galley. Berthing Areas, Ship's Offices and Labs/Workshops are typically assigned a 3 rating.

The FAL is loosely coupled to the MAL. For example a compartment rated 1 would be allowed to be lost much less frequently than a compartment rated 4. The equation that describes this relationship and an explanation of the variables are also included in Appendix B. The FSOs for the first three cutter classes analyzed in the SCFP were assigned based on the engineering judgment of the analyst mentally integrating the effects of a fire on life safety, property protection and mission. This process was refined for the last seven cutter classes analyzed in the SCFP where weighting factors were assigned to each of these considerations.

2.2.3. ENGINEERING ANALYSES MODULES

Engineering analyses comprise the other five modules in the SFSEM. Prevent EB is designed to analyze the actions taken to prevent a fire from occurring in the first place, as well as the initial actions taken by a person discovering a fire in its incipient stage. Flame Movement, Smoke Movement, People Movement, and Structural Frame are modules that analyze the ship's ability to respond to a fire that has reached EB. Each of these analyses is designed to provide information that will allow a comparison of the ship's performance relative to the established FSOs. The following sections provide an overview of each of these modules.

2.2.3.1. Prevent Established Burning Module

In fire protection engineering terms, Established Burning (EB) defines the point when radiational feedback to the fuel bed begins to predominate as the heat transfer mode and the heat release rate of the pyrolizing fuel will rapidly increase if proper conditions for combustion exist. From a layman's perspective, it is the smallest flame one would worry about. For example, a cigarette lighter flame would be of concern in a compartment such as a paint locker, but a flame would have to be considerably larger to be a concern in a cargo hold. The specific fire size that defines EB can thus range in size from a spark to a flame height of four feet or more. A ten inch high flame is commonly accepted as the smallest flame on a ship that constitutes EB.

The probability that EB will occur is equivalent to the probability that fire prevention failed. The probability of EB can be calculated by multiplying the probability of ignition times the probability that the fire will grow to the critical size defined as EB. Calculating this probability is

primarily useful in a study of the fire prevention phase, however, it is also used in the calculation of the probability of limiting flame spread.

The Prevent EB module analyzes the probability of EB occurring in a target compartment. There are two basic approaches to accomplish this analysis. The first approach calls for evaluating the probability of each event that would lead to EB including overheating, ignition, and growth from ignition to EB. The other approach is simply to analyze historical records if sufficient data exists.

Fire safety analyses of Coast Guard Cutters to date have utilized historical records to establish the frequency of EB since adequate data from the U.S. Naval Safety Center and U.S. Coast Guard Headquarters is available for each type of compartment aboard a cutter. Military ships, including Coast Guard Cutters, are required to report all fires that result in damage or personal injury. This provides the opportunity to utilize historical records to determine the frequency of EB. Historical data does not involve the subjective judgment required in determining probabilities. Therefore the alternative "frequency of EB" is utilized in the SFSEM.

Historical reports of fires on all classes of Coast Guard Cutters was obtained from the Commandant (G-KSE-4), U.S. Coast Guard, for the period 1984 through 1992. This data was combined with data received from the U.S. Naval Safety Center on 21 classes of large naval vessels during the period 1975 through 1986 to refine the reported fire frequencies. For the purposes of the SFSEM, similar compartments were grouped by compartment use indicator (CUI). CUI categories were adapted from the standard nomenclature used by the Coast Guard and Navy to identify compartment usage. Some CUIs were further subdivided in order to reflect a more accurate assignment of reported fire frequency. Experience has shown that some fires which reach EB do little or no damage to the vessel and result in no injuries to personnel; thus they are unreported. As a result, the “reported frequency of EB” based on historical data was doubled and called "adjusted fire frequency" to account for unreported fires. The number of fires reported and adjusted fire frequency values from the combined Navy and Coast Guard data is shown in Table 2.2 grouped according to CUI.

Note that the Main Propulsion Mechanical (EM) and Emergency Auxiliary Generator Rooms (QE) exhibit adjusted fire frequencies which are orders of magnitude greater than other compartments. This fact has a substantial impact on the results of a fire safety analysis using the SFSEM.

The data provided by the Commandant (G-KSE-4) was also analyzed to obtain information such as the frequency that arson is a problem, the frequency of fires that spread to other compartments from the room of origin, the class of fires that most frequently occur, the type of compartment where high dollar loss fires occur, etc.

Table 2.2 Fire Frequency Data

Type of Compartment	Compartment Use Indicator (CUI)	Number of Fires Reported	Adjusted Fire Frequency (1) (Fires per Compt Year)
Cargo Hold	AA	0 (2)	0.0001 (3)
Gear Locker	AG	19	0.0010
Refrigerated Storage	AR	3	0.0009
Storeroom	AS	34	0.0009
Ship Control Area	C	4	0.0012
Main Propulsion Electrical (4)	EE	7	0.0031
Main Propulsion Mechanical	EM	148	0.0272
Fuel Oil, Lube Oil Tank	F	0 (2)	0.0001 (3)
JP-5 Fuel Tank	J	0 (2)	0.0001 (3)
Hazardous Material Storage	K	4	0.0013
Berthing Space	L1, L2, L5	20	0.0008
Wardroom, Mess, Lounge Space	LL	7	0.0008
Medical, Dental Space (4)	LM	0	0.0001
Passageway, Staircase, Vestibule	LP	3	0.0001
Sanitary Space	LW	4	0.0002
Explosives Storage	M	1	0.0001
Auxiliary Machine Space (4)	QA	89	0.0029
Emergency Aux. Generator Room (4)	QE	23	0.0204
Fan Room	QF	7	0.0004
Galley Pantry, Scullery	QG	13	0.0026
Helicopter Hangar	QH	3	0.0036
Laundry	QL	5	0.0031
Office Space (4)	QO	5	0.0004
Shops, Labs	QS	15	0.0018
Trunk, Hoist, Dumbwaiter	TH	0 (2)	0.0001
Stack, Uptake	TU	5	0.0013
Void, Cofferdam	V	1	0.0001 (3)
Water, Peak, Ballast Tank	W	1 (2)	0.0004

NOTES:

1. Taken as twice the reported fire frequency
2. Based on 1986 - 1991 USCG data only. (All other numbers of fires based on both USN and USCG data.)
3. Default value used in cases where no fires have been reported, or when calculated adjusted frequency is below 0.0005
4. New compartment types added since analysis of three small cutters

2.2.3.2. Flame Movement Module

If a fire grows beyond EB, the goal of shipboard firefighting is to limit the spread of the fire to the room of origin. If the fire breaches the compartment boundaries (or barriers) in the room of origin, the fire may spread to involve adjacent compartments. Thus, from the perspective of flame movement, fire spreads from compartment to compartment by attacking and destroying the barriers separating the compartments. Fire will continue to spread if there is adequate fuel and oxygen to sustain fire growth. The SFSEM first evaluates the probability of extinguishing the fire in a room of origin; then it considers the probability of the compartment barriers successfully limiting the fire from spreading to adjacent compartments. Finally, it evaluates the probability of extinguishing the fire in the adjacent compartments, then the adjacent compartment's barriers are evaluated and so on. This process is repeated for every possible room of origin and every possible fire path until the probability of limiting the fire is 1.0 or until the user-specified time has elapsed, whichever comes first. Results are accumulated for each compartment as a target of fire and compared to FSOs. The results identify areas where fire protection systems need to be improved, and where they can be reduced and still achieve desired levels of fire protection. A key point in the flame movement module of the SFSEM is that the probabilities involved are determined based on engineering judgment or degree of belief of the analyst. While the methodology is fundamentally probabilistic, certain aspects in fire science lend themselves to deterministic solutions, and deterministic algorithms are incorporated wherever sufficient data exists to validate them. The philosophy also considers the fact that the human mind is limited in the number of factors it can integrate simultaneously. The framework of the SFSEM breaks all events into smaller subevents so that the analyst can focus his or her engineering judgment on relatively few factors, while the computer programs carry out the extensive calculations necessary to aggregate the results.

2.2.3.3. Smoke Movement Module

Fires produce smoke and toxic gases as products of combustion. In addition, certain firefighting agents create toxic gases in a fire or significantly reduce available oxygen. The obscuration from the smoke and the untenable atmosphere from the toxic gases more often result in a life-threatening situation than the flames themselves. An analysis of the smoke movement in a fire is therefore vitally important in determining the ship's performance relative to life safety objectives. Unfortunately, the analysis of smoke movement in a ship with its installed ventilation systems is extremely complex. Considerable research has been devoted to smoke movement by fire protection engineers in the academic as well as research and development communities. The smoke movement module will be the next module integrated into the SFSEM.

2.2.3.4. People Movement Module

In the event of a fire emergency on a ship, passengers and off-duty crew have to proceed to areas of refuge. On-duty crewmen in certain spaces such as the Bridge and Engineering Control Center cannot evacuate due to the need to operate the ship's propulsion and navigation systems. In wartime, battle stations also remain occupied during a fire due to the need to defend the ship and operate the ship's weapons systems. Consequently, certain compartments require fire protection systems adequate to protect occupants who cannot evacuate for one reason or another. The people movement module will be designed to analyze egress routes to areas of

refuge and evaluate the adequacy of fire protection systems for defending people in place. This module will be developed and integrated into the SFSEM in the future.

2.2.3.5. Structural Frame Module

Watertight bulkheads and decks on ships provide the necessary segregation for adequate protection against progressive flooding. The watertight compartments thus created are further subdivided with non-structural bulkheads to provide segregation of ship functions and accommodate the ship's missions. Most watertight boundaries in ships are steel to provide the necessary structural strength to resist the hydrostatic forces that may be encountered due to progressive flooding. The structural collapse of steel bulkheads and decks in the first hour or so of a fire is unlikely. However, some ships such as hydrofoils, fast patrol boats, surface effect ships and other weight-critical vessels are constructed of aluminum. This material loses structural strength at relatively low temperatures compared to steel. The structural frame module is intended to analyze the effects of fire on the structural members of the ship. This module will also be developed and integrated into the SFSEM in the future.

2.2.4. SFSEM APPLICATIONS

The flame movement module of the SFSEM is a probabilistic-based risk analysis methodology. This means that the results are based primarily on probabilities determined by engineering judgment of the engineer/analyst as opposed to deterministic calculations of conditions precisely known. Therefore, the results are the most useful when the analyst uses the methodology to compare outcomes on a relative basis. Analyzing competing preliminary designs to identify the best design with respect to fire safety is an example of such a potential application. It is also appropriate to compare, on the same ship, the effectiveness of different fire protection alternatives

The SFSEM has been used in the past to analyze the preliminary fire safety design of the Polar Icebreaker Replacement (PIR) and the WLM(R). It has also been used extensively in the SCFP to analyze the fire safety design of nine classes of active small U. S. Coast Guard Cutters. It has been demonstrated therefore that the SFSEM has utility to analyze proposed, as well as existing, fire safety designs of ships. The following sections describe the past as well as potential future applications for the SFSEM.

2.2.4.1. Fire Safety Design Analysis

The SFSEM permits an evaluation of individual fire protection components within a ship. It can compare alternative fire protection measures against a baseline or in a relative sense to each other. The basic flowchart for this process is illustrated in Figure 2.1. The SFSEM can be used to compare alternative fire protection components that are in the same category such as evaluating the effectiveness of different firefighting agents. Its true value, however, lies in its ability to compare heretofore incomparable entities such as evaluating the relative effectiveness of a barrier and a firefighting technique. This sort of comparison is especially useful to answer "what-if" questions often raised by decision-makers. Note that actual or proposed components can be evaluated on actual or proposed ships. Furthermore the SFSEM and the reports generated by SAFE provide the necessary documentation to support a serious study of the fire safety levels of these vessels.

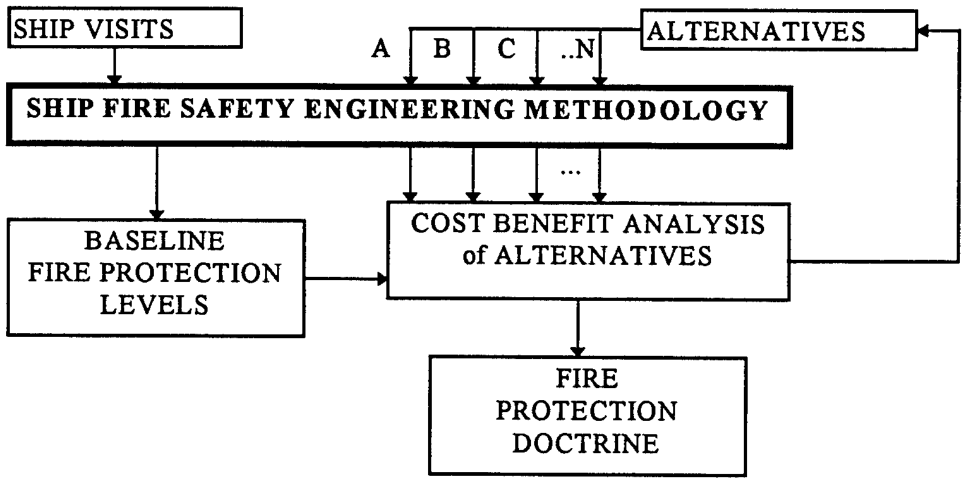

Figure 2.1 Role of the SFSEM in Fire Safety Design Analysis

2.2.4.2. Fire Investigations

The focus of fire investigations is usually a search for the cause or origin of the fire and frequently includes an investigation for negligence or dereliction of duty. Certainly, the loss of valuable property and lives warrants an investigation and a determination of responsibility, but the performance of the ship as a fire safety system is often overlooked. Moreover, there has been a lack of analytical tools with which to assess this performance. The SFSEM is not the proper tool to conduct a forensic type of fire reconstruction analysis. There are deterministic computer fire models which are more appropriate for this type of analysis. However, the SFSEM can be used to analyze the possible fire paths compared to the actual fire paths to gain insight into the ship's response to the fire. Furthermore, most ships are one vessel in a class of similar ships. An analysis of a fire may yield valuable information which would benefit the rest of the class.

2.2.4.3. Future Applications

In the future, the SFSEM may be used for equivalency determinations. The SFSEM provides the ability to quantify the contribution of fire protection features such as passive, automated, or manual firefighting features to achieve FSOs. Therefore, the means exists to verify an equivalent feature. For example, installing an automated fire protection system such as a sprinkler may be determined equivalent to the passive fire protection currently provided by the existing watertight boundaries which act as fire boundaries. The SFSEM does not take into account flooding, therefore removing an existing bulkhead may be compensated by installing the sprinkler system <u>for the purposes of fire safety</u>, but flooding the "larger" compartment thus created may result in the ship sinking. The SFSEM only considers fire safety related issues.

The effectiveness of damage control teams in response to shipboard fires varies considerably from ship to ship. Even within a ship, the response can vary between daytime and nighttime and especially over a period of time following firefighting team training. The evaluation

of the time between initial notification of the Bridge and the agent application is one of the significant variables. This variable could be used as the basic standard of measurement for damage control firefighting teams. Evaluation of this base measure, compared with other measures of firefighting agent delivery, can provide evaluation of levels of fire protection for different compartments within the ship or a comparison of different ships within the same class. This would serve to point out areas where damage control training was deficient. The SFSEM could also be used in a similar manner to evaluate the effectiveness of the ship's fire protection doctrine.

2.3. SAFE OVERVIEW

2.3.1. SAFE FRAMEWORK

SAFE is a programming system that automates portions of the SFSEM. It is actually an integrated series of programs requiring engineering evaluations, ship geometry, and ship features as input. SAFE employs both AutoCAD and an external database in order to organize the large amounts of data required to perform a fire safety analysis, to provide a user-friendly and manageable means of data entry, and to display the results in a meaningful manner. SAFE enables a person to describe the layout of a ship through AutoCAD, enter data values for compartments and barriers into a database, and run a probabilistic fire model on a ship. These data values, as well as results of running the probabilistic model, can be output in tabular and/or graphical form. The SAFE User Manual provides the details necessary to use SAFE to conduct a fire safety analysis on a ship. [11] Version 1.0 was used in the PIR study. Versions 2.0, 2.1 and 2.1A were used to analyze the ten classes of small cutters. The analyst should be a fire protection engineer with shipboard experience.

2.3.2. AUTOCAD

SAFE requires an accurate representation of the ship's geometry in order to determine connectivity between compartments and thus predict fire growth through these compartments. To provide this geometry, the coordinates of the corner points ("vertices") of each compartment's deck, the compartment elevation, and the compartment height are needed. SAFE utilizes AutoCAD as a tool for drafting a simplified version of the general arrangement deck plans of the ship so this information can be obtained. AutoCAD is also used to tailor default values assigned by the database and to display graphic results of the analysis.

2.3.3. DATABASE

The database is loaded, using information from the AutoCAD drawing and database entry screens, with all the values it needs to run the probabilistic model. General ship information is entered through a database screen, then the ".dxf" (drawing exchange format) files created in AutoCAD are used to calculate the ship geometry. Once the ship geometry is complete, information from the ship visit forms are entered. Certain fire parameters are assigned default values. AutoCAD permits tailoring these default values. Database reports are available to display fire parameters assigned to each compartment and barrier.

2.3.4. PASCAL PROGRAMS

Integrated into SAFE are numerous Pascal programs which provide three critical functions of the SFSEM:

- Connectivity Generation. Based on the AutoCAD drawings, SAFE determines the connectivity between compartments. Specifically, it determines which segments of bulkheads and decks are in common between compartments. Modelling this correctly is important because the SFSEM relies on the principle that fire spreads from one compartment to another by attacking and destroying the barriers between compartments.
- FRI Time and Heat Release Rate Calculations. The FRI time algorithm utilizes the Beyler-Peatross algorithm. [12] The coefficients for this algorithm are based on full-scale shipboard testing at the USCG Fire and Safety Test Detachment in Mobile, Alabama. The post-FRI heat release rate calculation is based on compartment ventilation assuming "worst case" stoichiometric burning (adequate oxygen to support combustion of all available fuel).
- Probabilistic Modeling. A run of the fire model begins with a compartment which has experienced ignition and fire growth to the point where the fire size meets the definition of "EB". At the point when EB is reached, the clock is set to time 0 (minutes) in the compartment referred to as the room of origin. The fire is allowed to grow until FRI is achieved in the room of origin or until the flames are limited by passive, automated or manual means prior to FRI. The variables in the equation that describes fire growth in the pre-FRI fire growth regime are explained in the Theoretical Basis of the SFSEM [2]. If FRI is achieved however, the model then calculates and accumulates the heat energy impact on the barriers in the room of origin and determines the probability of failure for each barrier from the catalog of Tbar and Dbar curves for barrier materials. Heat energy impact is calculated in the post-FRI fire growth regime according to the model for heat release rate assuming stoichiometric burning. If a barrier failure occurs, EB is established in the adjacent compartment and the fire growth cycle is started again. This space-barrier progression is allowed to continue until the fire is limited or until a predetermined, user-specified time has elapsed. In this space-barrier propagation, the probabilistic model builds a set of fire paths from each possible room of origin and accumulates results so that the compartments may be rank ordered in their performance as "targets" of the fire compared to the established FSOs.

2.3.5. COMPARISON OF SAFE VERSIONS 2.1A AND 2.2

Version 2.2 of SAFE was used in the analysis of the VINDICATOR. This version contains many improvements over versions 2.1 and 2.1A which were utilized in the SCFP. The majority of these improvements deal with making SAFE easier and more flexible to use, but several changes, which are outlined below, may affect the results of a fire safety analysis.

- An option was incorporated into the probabilistic model which allows a flammable liquid line rupture (FLLR) to be simulated. This option allows a scenario to be created whereby a user-specified engineering compartment is selected as the room of origin experiencing a FLLR. Its I value, FRI time, and liquid fuel load may be modified by the user to more accurately reflect the increased probability of fire propagation associated with a FLLR scenario.
- The user was given the ability to adjust FRI times for individual compartments. In prior versions, if a user was dissatisfied with any compartment's calculated FRI time, he or she

could only adjust input values and recalculate FRI time. With version 2.2, the calculated FRI time itself may be adjusted.

- The probabilistic model's barrier option was altered to allow the user to focus on which compartments are the most problematic as compartments of fire origin. It shows an ordered list of barriers in the room of origin sorted by those with the highest probability of failure given EB and a second list of the same barriers sorted by those with the highest frequency of failure given Fire Free State (FFS).
- The frequency of EB in Medical and Dental Spaces (CUI=LM) was changed from 0.0004 to 0.0001 fires per compartment year. No fires on Coast Guard cutters have been reported in these spaces over the eight year period of time when frequency data was tabulated. None of the ships analyzed using SAFE 2.1 and 2.1A had Medical and Dental Spaces, so this frequency change had no impact on prior analyses.
- Qmax values for fire growth models 1-6 and 8-10 were improperly calculated in SAFE versions 2.1 and 2.1A. This was corrected in version 2.2 and generally resulted in slightly lower Relative Loss Factors in target compartments.
- The formula for converting gallons of flammable liquid fuel to an equivalent amount of cellulosics in pounds was increased from 6.8 pounds per gallon to 8.0 pounds per gallon. This represents the conversion for fuel oil which is the predominant liquid fuel on board Coast Guard cutters.

2.4. FIRE SAFETY ANALYSIS PROCEDURE

A fire safety analysis is conducted in the following phases:

- Preliminary Fire Safety Analysis. A preliminary analysis is conducted and documentation is collected in conjunction with a visit to the ship when possible. Information required to run the computer programs associated with the SFSEM is also collected and verified during this stage.
- Detailed Fire Safety Analysis using SFSEM/SAFE. The SFSEM and its implementing computer programs, SAFE, are used to perform a detailed fire safety analysis of existing "baseline" fire protection levels and to study hypothetical changes to the fire safety design of the ship.

The following sections will address various aspects of the process used to analyze cutter fire safety.

2.4.1. PRELIMINARY FIRE SAFETY ANALYSIS

Information required to conduct a preliminary fire safety analysis is collected during the ship visit. The ship visit has the following specific purposes as explained in the Theoretical Basis of the SFSEM [2]:

- Conduct fire safety audit
- Collect detailed information to accomplish the fire safety analysis using the SFSEM/SAFE
- Collect and review all relevant documentation concerning firefighting procedures
- Observe fire drill

The fire safety audit is conducted to identify existing passive and active fire protection features and procedures, determine fuel loads and any unusual fire hazards, and to evaluate the accessibility of compartments for firefighting and egress routes for personnel. When possible, a fire drill is observed to assess the characteristic time it takes to set ZEBRA and to enable the analyst to assess manual firefighting effectiveness. The cutter's Main Space Fire Protection Doctrine, Casualty Control Manual, Compartment Check-off Lists, and Repair Locker Inventory and other critical information regarding the cutter's firefighting procedures is collected and reviewed. The results of this review are organized according to the phases in the life cycle of a fire commencing with prevention, and proceeding through detection, containment, and extinguishment. These four phases are discussed in the following sections.

2.4.1.1. Prevention

The four basic principals of fire prevention which should be observed routinely to reduce shipboard fires are:

1. Frequent inspections
2. Proper stowage of combustibles
3. Training and education
4. Enforcement of fire prevention policies and practices

The fire prevention phase also includes first aid or the initial attempts to extinguish a fire after ignition occurs but before the fire grows substantially beyond the point described as EB. The ship is examined for adherence to the four principals described above and to identify procedures and equipment the ship routinely uses for first aid.

2.4.1.2. Detection

There are two ways a fire can be detected on board ship - by a crew member or by an installed monitoring device. As the proposed crew levels decrease with the minimal manning concept, it becomes more important to install a sophisticated and comprehensive fire detection system to ensure early detection of fire while the fire is small and more amenable to extinguishment. Moreover, fire grows exponentially with time, and it is significantly easier to extinguish a small fire than a large fire. All compartments are reviewed for the presence and operating condition of required monitoring devices. The ship's watch quarter and station bill is reviewed to help determine manning levels in compartments during various operating conditions.

2.4.1.3. Containment

If a fire grows beyond EB, it is desirable to contain the fire within the room of origin to minimize the damage. Containment of a fire can be accomplished through passive or active means. Passive measures include adequacy of compartmentation, use of non-combustible construction materials, and control of quantity, type and distribution of fuel loads. Active

measures include setting condition ZEBRA and securing ventilation, fuel and electrical power in the affected spaces. All bulkheads and decks which serve as barriers to contain the fire are examined to determine their adequacy for this purpose. The existence and location of isolation valves, remote shutdowns, and fire dampers and their operating condition is also observed and noted.

2.4.1.4. Extinguishment

Extinguishment requires appropriate firefighting equipment in strategic locations, adequate protective equipment and clothing for firefighters, and personnel adequately trained to operate the equipment and work as a team. Firefighting equipment includes both manually operated and automatic/automated systems. Protective equipment and clothing include emergency escape breathing devices, oxygen breathing apparatus (OBA), firefighting ensembles, flash gear, etc., and hand held detection devices such as firefinder or naval firefighting thermal imager (NFTI). The ship is thoroughly inspected to identify the location, type, size and number of firefighting equipment onboard. The damage control lockers are inspected for contents and the fire protection doctrine reviewed. The state of crew training in firefighting procedures is also ascertained if possible.

2.4.2. DETAILED FIRE SAFETY ANALYSIS

A nine step procedure for conducting a detailed fire safety analysis using the SFSEM/SAFE has been developed and refined over the course of conducting previous analyses. Prior to conducting the analysis, it is necessary to obtain the ship's general arrangement drawings in AutoCAD. This may require a preliminary ship visit to obtain the information necessary to properly model the ship's geometry. Once the ship has been modeled in AutoCAD, the following procedure is used to perform a complete fire safety analysis:

1. Load Database With Ship's Geometry
2. Conduct Ship Visit
3. Load Safe Input Value
4. Calculate FRI Times and Post-FRI Heat Release Rates
5. Run Probabilistic Model
6. Analyze Baseline Results
7. Analyze Fire Protection Alternatives
8. Conduct Cost-Benefit Analysis
9. Document Results

These steps are discussed in the following sections.

2.4.2.1. Load Database with Ship's Geometry

The simple, yet accurate, representation of the ship's geometry created in AutoCAD is utilized by SAFE's connectivity generator to produce a listing of all compartments on the ship. Also produced is a listing of each compartment's barriers which connect it either to other

compartments or to the weather. Once these lists have been verified for accuracy, they are loaded into SAFE's database and ship visit forms are produced.

2.4.2.2. Conduct Ship Visit

The SFSEM/SAFE requires an extensive amount of data to facilitate an analysis of the cutter's fire safety. Preprinted ship visit forms ensure information concerning fuel loads, compartmentation, ventilation, FSOs and other required data is collected in an efficient manner. This information is also used by the engineer/analyst to temper the engineering judgment required to develop the probabilistic values entered into SAFE.

It is essential that the engineer/analyst personally visit the ship. During the ship visit, the engineer/analyst:

- Completes the ship visit forms and verifies the accuracy of all information on the preprinted forms.
- Photographs compartments to document fuel loads, unusual fire protection features, accesses, egress routes, ventilation openings, etc.
- Ideally, observes an "in port" fire drill and notes the time to set condition ZEBRA. If it is impractical to observe an actual fire drill, the characteristic time to set ZEBRA may be obtained from the ship's records.
- Obtains copies of the ship's main space fire doctrine, casualty control manual, and compartment check-off lists if these documents were not previously collected.
- Discusses with the Commanding Officer and Operations Officer the various missions of the ship and which compartments contain equipment which supports these missions. This information aids in establishing realistic fire safety objectives (FSOs).
- Discusses with the Engineering Officer and Damage Control Assistant (DCA) the state of the crew's firefighting training. In addition, the general condition of the ship (whether it is well maintained and clean or not), and the overall attitude and sense of pride in the ship the crew displays is noted. This information is used in the determination of certain input values which are assigned by engineering judgment.

The quality of the fire safety analysis is directly proportional to the quality of the information collected during the ship visit. Typical small cutter ship visits requires two working days for two engineer/analysts. Large cutters may require additional time.

An actual ship may not exist to visit and the engineer/analyst may find it necessary to work with preliminary designs of the proposed ship. In this event, the engineer/analyst should visit a similar ship (in size, design, and mission) to aid the engineer's judgment in predicting what the input values will be once the ship is built. In addition, the Circular of Requirements (COR) and information provided by the shipyard, can augment the knowledge gained by visiting a similar ship.

2.4.2.3. Load Safe Input Values

This step includes refining the ship's geometry with any new information gathered during the ship visit, determining all required fire parameters, performing the data entry of the information on the ship visit forms and verifying the accuracy of the data entry. The values now

in the database comprise the "baseline data set" for the ship. This baseline data set permits discrimination from data associated with hypothetical alternatives that may be analyzed later in the analysis.

The probabilities of flame termination and barrier failure in each compartment are the key values the analyst determines based on engineering judgment. There are three ways a fire can occur in a compartment. The fire can:

1. Originate in the compartment (EB)
2. Enter from an adjacent compartment via a hot spot or thermal failure (Tbar) of a connecting barrier
3. Enter from an adjacent compartment via a massive or durability failure (Dbar) of a connecting barrier.

There are also three ways a fire can be limited or terminate in a compartment:

1. Self extinguishment (I),
2. Suppression by automated/fixed fire extinguishing systems (A),
3. Manual suppression (M).

Therefore, a 3 x 3 matrix of nine probabilities of flame termination are required to completely characterize the probability of flame limitation in each compartment. Probability is the numerical measure for expressing the likelihood of an event. The terms probability, likelihood, and degree of belief are considered to be synonymous in this context. The numerical measure of probability can vary from zero to one. A probability of zero indicates that an event will never happen, while a value of one indicates that it will always happen. A value between zero and one indicates the relative likelihood of the occurrence of the event, in this case, the probability that a fire will be limited or extinguished. Probability is often expressed as a percentage between 0 and 100, as is the case with the values in Table 2.3 below.

Table 2.3 is an example of the probabilities that are assigned to a typical engine room. This table shows that it is more likely that a fire will be limited if the fire enters the compartment as a result of a hot spot failure in a bulkhead (Tbar) than if it enters the compartment as a result of a massive failure of the bulkhead (Dbar). Moreover, it is least likely for a fire to be limited if the fire originates in the compartment (EB). Similarly, it is more likely that automated/fixed systems will limit a fire than manual firefighting efforts because these systems tend to be reliable and use highly effective firefighting agents such as Halon 1301 or CO_2 compared to water typically used by firefighters. A fire is also more likely to self extinguish than be suppressed by manual firefighting efforts. These probabilities are assigned based on engineering judgment of the. engineer/analyst tempered by the values assigned to similar compartments on other Coast Guard Cutters.

Table 2.3 Probabilities of Flame Termination in a Typical Engineroom

	EB	Tbar	Dbar
I	40	48	44
A	90	99	99
M	20	24	22

A catalog of barrier materials exists for a number of different barrier materials commonly encountered in ship construction. The catalog contains graphs which plot probability of failure versus heat energy impact for each barrier material for each failure mode (Tbar and Dbar). The key points on these curves are tabulated in Attachment B.2.1 to Appendix B. These values were determined using engineering judgment by the engineers/analysts who encountered these materials. The procedures for establishing Tbar and Dbar curves will be documented in the next revision to the Theoretical Basis of the SFSEM [2].

In addition to the probabilistic values assigned to compartments and their barriers, other more deterministic values collected during the ship visit are also loaded into the SAFE database. MAL and FAL, the two components of Fire Safety Objectives as discussed in Section 2.2.2, are entered into SAFE at this time as well.

2.4.2.4. Calculate FRI Times and Post-FRI Heat Release Rates

After all input values have been assigned, the Full Room Involvement time (FRI time) and post-FRI heat release rates are calculated for each compartment. FRI times may be reviewed and adjusted, or input values used to calculate FRI may be adjusted and FRI may be recalculated. FRI times are calculated in SAFE in accordance with the Beyler/Peatross algorithm [12]. Basically, this algorithm calculates the time in minutes for the temperature in a compartment to rise 500 degrees Celsius. This elapsed time is referred to as FRI time. The major variables include the pre-FRI heat release rate of the burning fuel, the heat lost through the barriers and the incoming air. The coefficients for this algorithm were determined from full-scale ship fire tests conducted at the U. S. Coast Guard Fire Safety Test Detachment, Mobile, AL.

The variables in the post-FRI heat release rate calculation are included in the ventilation factor: $A*H^{0.5}$. This factor takes into account the height and area of a single vertical ventilation opening which is providing natural (unforced) ventilation. The coefficient for this variable is based on the worst-case assumption of stoichiometric combustion. Some ship compartments are served by multiple vents and frequently use forced ventilation through horizontal vents; thus, determining vent opening height becomes problematic. An appropriate post-FRI heat release rate deterministic algorithm, validated by full scale ship tests, is one of the areas of improvement needed in the continuing development of the SFSEM.

2.4.2.5. Run Probabilistic Model

Once the database has been loaded with all required input, the probabilistic model is run on the baseline data set to establish the baseline fire safety levels of the ship. Several parameters have to be specified in order to run the model. These parameters are specified in "scenarios".

Standard scenarios include conditions normally encountered on board ship, whereas non-standard scenarios permit altering these conditions to permit a more robust analysis. A more detailed discussion of scenarios is provided later in this section.

An important parameter that has to be specified in a scenario is the material condition of readiness. A cutter is typically in material readiness condition XRAY (all access closures, valves and fittings marked "X" closed) or YOKE (all access closures, valves and fittings marked "X" or "Y" closed). Condition ZEBRA (all access closures, valves, and fittings marked "X," "Y," or "Z" closed) is set only in emergencies such as fire, collision, or enemy attack. SAFE simulates the setting of condition ZEBRA during a model run after a calculated "time to detection" plus a "time to set ZEBRA" has been reached.

The ship is normally in port or at sea. In port, material condition XRAY is usually in effect during working hours, otherwise condition YOKE is set (at night and on weekends for example). At sea, material condition YOKE is normally set. Since the doors and other accesses serve a vitally important role in containing fire spread it is necessary to specify the material condition of readiness in the scenario so that the SFSEM properly models the status of the doors, scuttles, hatches, windows, etc.

A scenario in SAFE includes user-defined parameters such as material condition of readiness, ship location (at sea or in port), firefighting configuration, barrier failure criteria, simulation run time, etc. Standard scenarios are established to describe operating conditions for the cutter over the majority of its life cycle as shown in Table 2.4. A non-standard scenario specifies varying levels of fire protection in effect as shown in Table 2.5. Note that all three lines of defense are in effect (I, A, and M) in all three standard scenarios shown in Table 2.4. Certain conditions on some ships result in virtually no difference in the two in port standard scenarios or in the two YOKE scenarios. In these cases, the three standard scenarios may be reduced to two.

Table 2.4 Standard Scenarios

Scenario #	1	2	3
Configuration	X-RAY	YOKE	YOKE
Location	In-Port	In-Port	At-Sea
Fire Protection Level	I, A & M	I, A & M	I, A & M

Table 2.5 lists nine non-standard scenarios (scenarios 4 through 12) which describe "other than normal" conditions. For example, in order to evaluate the ship's response to a fire while underway without considering the contributions provided by automated (A) or manual (M) firefighting, scenario number 12 in Table 2.5 would be utilized. This scenario describes the ship at sea, under normal steaming conditions, but does not include the contributions provided by any automated/fixed fire protection systems or the manual firefighting efforts of the crew.

Table 2.5 Non-Standard Scenarios

Scenario #	4	5	6
Configuration Location Fire Protection Levels	X-RAY In-Port I & A	YOKE In-Port I & A	YOKE At-Sea I & A
Scenario #	**7**	**8**	**9**
Configuration Location Fire Protection Level	X-RAY In-Port I & M	YOKE In-Port I & M	YOKE At-Sea I & M
Scenario #	**10**	**11**	**12**
Configuration Location Fire Protection Level	X-RAY In-Port I	YOKE In-Port I	YOKE At Sea I

2.4.2.6. Analyze Baseline Results

The first step in the detailed fire safety analysis of a ship with the SFSEM is a determination of its existing fire safety. To facilitate discussion, this result is referred to as the "baseline". Baseline Data Sets reflect input values to the SAFE program which are based on the physical condition of the ship found during the ship visit and are not influenced by any modifications or alterations which may be proposed as a result of this analysis.

The baseline analysis is designed to identify compartments which fail to meet FSOs so that attention can be focused on these compartments. Ideally, multiple hypothetical alternatives are identified and studied that improve the fire safety to minimally acceptable levels. A cost-benefit analysis can then be conducted to form the basis for recommendations.

When a scenario is specified for the probabilistic model, the user may select from a variety of output options including, but not limited to:

- Individual Target Option which provides results of individual compartments as targets of fire. This option provides a rapid look at all compartments and their performance compared to fire safety objectives.
- Target Set Option which considers sets of mission-critical compartments as targets of fire. This option is also useful for analyzing the fire safety of the entire ship as a fire safety system.
- Barrier Option which provides details for plotting the probability of flame limitation in each compartment (L curve) and the probability of failure of its associated barriers. This option is useful for considering a limited number of compartments in detail.
- Path Option which provides details of all fire paths from a single room of fire origin. Unlike the target options, the barrier and path options do not normalize results compared to FSOs.

Results from all options are available as summary and detailed level reports. The individual target option results may also be displayed graphically. The individual target option has been utilized most extensively to conduct a fire safety analysis. It produces Relative Loss Factors (RLFs) for each compartment which represent a relative comparison of a compartment's frequency of loss with its FSOs.

The results of using the individual target option with the standard scenarios on the baseline data set are carefully examined to determine how well the ship performs as a fire safety system in response to a fire. This is accomplished by examining RLFs for "target" compartments. RLFs greater than 1.0 indicate the target compartment failed to meet the FSOs established for that compartment and an improvement in fire protection is needed. A target compartment with a RLF equal to 1.0 indicates the compartment meets its FSOs. A target with a RLF less than 1.0 indicates the compartment exceeds its FSOs and a reduction in fire protection may be acceptable. There are at least three possible reasons that a compartment fails to meet FSOs (more than one can apply):

- The target compartment itself lacks adequate fire protection.
- Another compartment is responsible for fires that spread and ultimately involve the target compartment.
- FSOs for the target compartment were not set properly.

Note that the results from the individual target option focus on the target compartments which do not meet their FSOs, they do not provide any insight as to the primary sources of the fires that ultimately caused the loss of the targets. Determining the source, or cause for each failed compartment may involve running the probabilistic model with different output options such as the barrier or path options. For example, the path option may yield information that many of the fire paths that ultimately involve the target compartment actually originate in another compartment. Thus improving the fire protection in the appropriate room of origin may improve the results in the target compartment as well as the room of origin!

2.4.2.7. Analyze Fire Protection Alternatives

To determine ways to improve the fire safety of compartments which fail to meet FSOs, or less typically, to determine ways to reduce fire safety in over-protected compartments, hypothetical alternatives may be efficiently analyzed in SAFE. The alternatives studied should be consistent with the goals established by the sponsor. For example, in the SCFP the sponsor's goals for the ten cutter classes analyzed were: (1) reduce the dependence on manual firefighting without a reduction in fire safety levels for the cutter and, (2) identify potential improvements to fire safety so that all compartments meet FSOs in all three standard scenarios. These goals were achieved by running non-standard scenarios (Manual Firefighting "turned off"), then modifying the baseline data set for alternatives that enhance Passive or Automated Firefighting to determine if the improvement is equivalent to the contribution provided by manual firefighting. This step can be a protracted exercise but should be continued until the goals of the analysis are achieved or until all reasonable alternatives have been analyzed.

An alternative data set modifies the parameters of the baseline data set such that it represents the conditions that would be in effect if that alternative were installed on the cutter. Baseline or alternative data sets may be analyzed in combination with standard or non-standard scenarios to consider various alternatives. Once the situation is defined by the analyst, values are assigned that numerically represent the appropriate probabilities involved. Alternatives may also be rank-ordered by RLF for their effect on fire safety (i.e. lower RLFs equate to greater fire safety).

This step usually involves analyzing alternatives to identify improvements in compartments which fail to achieve FSOs. In those cases where the baseline fire safety levels exceed FSOs by a substantial margin in all compartments, no improvements would be indicated. In these cases this step can still serve a useful purpose. For example, certain features of the existing fire safety design may be hypothetically eliminated so that the effect on fire safety can clearly be demonstrated or justify a recommendation to eliminate "over-protection". Another "alternative" may be to study certain fire safety features to achieve the sponsor's objectives. For example, the sponsor may desire to identify an equivalent barrier, or firefighting agent, even though FSOs are being achieved. Thus the effect of replacing Halon with CO_2 or AFFF could be studied to determine the effect on fire safety levels due to the fact Halon causes severe environmental damage.

2.4.2.8. Conduct Cost-benefit Analysis

If multiple alternatives are identified, a cost-benefit analysis can be conducted to recommend the more cost effective alternatives. Alternatively a weight-benefit or volume-benefit analysis may be substituted depending on the sponsor's objectives. In either event, the "benefit" is quantified by the improvement in the RLFs. The "cost" should take into account the direct and indirect costs of implementing the change. For example the weight, volume or price are examples of direct costs while inconvenience to the crew, damage to the environment, or impact on other missions are examples of indirect costs.

2.4.2.9. Document Results

The final report should document the results of the baseline analysis and consideration of all alternatives. Reports from SAFE can be generated and included to provide supporting data. Graphic reports from SAFE (including color-graphics) can significantly enhance the report. For example SAFE can generate deck plans which portray compartments which fail to meet FSOs in red, while compartments colored yellow, green or blue are progressively "safer".

2.5. PREVIOUS FIRE SAFETY ANALYSES USING SFSEM/SAFE

2.5.1. POLAR ICEBREAKER REPLACEMENT (PIR)

The preliminary design of the U.S. Coast Guard PIR was analyzed using the SFSEM/SAFE in 1987. [13] This project was important for several reasons. It was the first formal fire safety analysis of a preliminary design of a Coast Guard Cutter. It was also the first time that U.S. Coast Guard naval engineers/management delineated FSOs in detail. Finally it was the first major application of this methodology. The results are considered highly satisfactory; Coast Guard management realized their assessment of FSOs was too lenient but that the exercise has merit. The analysis pointed out several deficiencies in the fire safety design such as identification of redundant fire protection systems and where additional barriers should be installed. The project also served to identify areas where the SFSEM needed further development. Version 1.0 of SAFE was used for the PIR.

2.5.2. CGC VIGOROUS (WMEC 627)

A fire safety analysis of the Coast Guard Cutter VIGOROUS was conducted as a term project in a graduate level course in fire protection engineering at the Worcester Polytechnic

Institute in 1990. [14] The methodology inherent in the SFSEM was utilized to analyze compartments below the main deck. The focus of this evaluation was on machinery, storage, and habitability areas. The analysis served two important purposes, first it pointed out the need for a computer program to automate the calculations so that a thorough analysis could be conducted in a reasonable time. Secondly the methodology was shown to be appropriate to identify deficiencies in the fire safety design of the vessel. In the case of the VIGOROUS it was clearly evident that the major deficiency was lack of an automatic fire detection system. The analysis also identified weaknesses in the fire protection systems for five specific compartments below the main deck. The SFSEM facilitated an evaluation of alternative fire safety designs to alleviate these problems. The project team also conducted a limited analysis of an actual fire on VIGOROUS that occurred in 1989. While this effort yielded some interesting results, in general, the SFSEM should not be used to conduct a forensic-type post-mortem analysis of a real fire.

2.5.3. SMALL CUTTER FIRE PROTECTION PROJECT (SCFP)

The SCFP Project was a comprehensive effort to analyze the fire safety of small U.S. Coast Guard Cutters between 65' and 180' in length. The final reports in the project document and summarize the major results, conclusions and recommendations provided in the four interim reports submitted during the course of the project. [3, 4, 15, 16, 17, 18] In addition, the final reports include a detailed fire protection doctrine tailored for ten classes of Patrol Boats, Tugboats, and Buoy Tenders. Each cutter class doctrine provides information pertinent to fire science in part A, firefighting policy and guidance provided by the Commandant, U.S. Coast Guard for small cutters in part B, and procedures for combating all classes of fires in all conceivable compartments in part C.

The SAFE programs, versions 2.0, 2.1 and 2.1A, were utilized as the analytical tool to conduct a comprehensive analysis of the baseline fire safety and hypothetical improvements to achieve pre-established FSOs in the SCFP. Results indicate that the majority of compartments in small cutters meet FSOs with their existing passive and active fire protection features in effect. The methodology was shown to be a valuable tool to evaluate heretofore incomparable entities such as a better barrier or a more effective firefighting system and quantify their effectiveness. This study clearly demonstrates that it is feasible to reduce reliance on manual firefighting in small cutters by enhancing selective passive and active fire protection features. This study also identified several areas where the SFSEM could be enhanced to improve its effectiveness. Recommendations are also made to improve the fire safety of the cutters studied.

2.5.4. MAIN VERTICAL ZONE LENGTH EVALUATION

The SFSEM was used to study the impact on fire safety of a proposal to exceed the maximum length of a main vertical fire zone on a riverboat. This project was accomplished by a six member team as a term project in a graduate level course at Worcester Polytechnic Institute in 1993. The maximum length of vertical fire zones was established by the Safety of Life at Sea (SOLAS) convention. The U.S. Coast Guard is responsible for regulating domestic ship construction and is frequently faced with the need to make a decision concerning equivalencies to requirements specified in the Code of Federal Regulations and applicable SOLAS regulations. The analysis revealed that lengthening the main vertical fire zone in this case actually decreases the fire growth hazard potential. This project was significant in that it demonstrated the feasibility

of using a performance based methodology such as the SFSEM to assist in judgments of proposed equivalencies to prescriptive fire regulations.

3. FIRE SAFETY ANALYSIS OF THE USCGC VINDICATOR (WMEC 3)

The most important objective in this project is to evaluate the fire safety of the VINDICATOR as configured for use as a Medium Endurance Cutter in the Coast Guard fleet. The basic technical approach includes a thorough analysis of the cutter's existing fire protection levels and certain design features that directly pertain to fire safety. A fire protection doctrine is also required that includes firefighting procedures for all classes of fires in all types of compartments, in port and at sea. Finally, due to the protracted period of time the VINDICATOR will be at the Coast Guard YARD, an analysis of fire safety in this particular "in-storage" scenario was performed.

The following sections of this report will address the specific results of the fire safety analysis conducted on the VINDICATOR and which culminated in the development of the fire protection doctrine discussed in section 4.0 and documented in Appendix D of this report. These aspects include:

- Preliminary Fire Safety Analysis. A preliminary fire safety audit was performed and documentation collected in conjunction with a visit to the Coast Guard YARD where the VINDICATOR is being converted from a T-AGOS class vessel to a WMEC. Information required to run the computer programs associated with the SFSEM was also collected and verified during this stage. Special attention was also paid to the conditions that will be prevalent during the two years the vessels will be in storage at the YARD insofar as they may affect fire safety.
- Detailed Fire Safety Analysis using SFSEM/SAFE. The SFSEM and its implementing computer programs, SAFE, were used to perform a detailed fire safety analysis of existing "baseline" fire protection levels and to consider certain specific aspects of the ship's design and conversion specifications that directly affect fire safety. In addition the SFSEM and SAFE were used to specifically analyze the in-storage fire scenario at the Coast Guard YARD.

3.1. PRELIMINARY FIRE SAFETY ANALYSIS

The preliminary analysis stage of this project included a trip to the U.S. Coast Guard YARD to conduct a ship visit on the VINDICATOR. The YARD had removed the SURTASS and associated communications equipment used for towing a passive sonar array and reporting the collected data, painted the ship white, and commenced planning the rest of the conversion project. In addition, the conversion specifications and drawings were prepared and were constantly being changed. Significant compartmentation changes were planned particularly in the berthing, messing and living spaces, as well as the areas previously occupied by the SURTASS and related equipment. Due to the need to facilitate the purchase of construction materials with a lengthy procurement cycle, the preliminary analysis phase of this project was expanded to include a preliminary report on the results of the baseline fire safety analysis [19]. A briefing on the interim results was provided in December 1994. Results from the preliminary report and briefing are incorporated in the following sections of this report as well as the next section, 3.2. The preliminary analysis is discussed in Sections 3.1.1. through 3.1.4. and are organized according to the life cycle of a fire commencing with prevention and progressing through detection,

containment and extinguishment. Although not part of the life cycle of fire, sections 3.1.5 - 3.1.7 provide a discussion of three topics related to fire safety of the VINDICATOR which were studied during the preliminary analysis phase of this project. Section 3.1.5 discusses potential locations for an additional repair locker. Section 3.1.6 deals with the impact on fire safety of long-term storage at the Coast Guard YARD. Section 3.1.7 includes a review of historical fire safety records for Medium Endurance Cutters in the Coast Guard.

3.1.1. PREVENTION

A review of all available documentation such as the drawings, conversion specifications, etc. and a visit to the YARD revealed the existence of the following fire safety hazards and unusually high fuel loads on the VINDICATOR:

- 3/4" thick marine plywood is used extensively as joiner paneling throughout the Main Deck, 01 Deck and 02 Decks. This plywood appears to have a decorative melamine laminate facing or veneer on the exposed side.
- One-piece fiberglass toilet-shower combinations are installed in all of the officer and enlisted berthing areas.
- The Main Deck, 01 Deck and 02 Decks have celotex dropped ceilings which segregate large utility void spaces above the staterooms, offices, lounge spaces, etc. Moreover, these void spaces encompass several compartments below since the joiner paneling is not carried to the underside of the deck above, rather they terminate at the height of the joiner paneling.
- There is no dedicated Paint Locker compartment inside the ship. There are two small paint lockers on the 02 weather deck; however, they are inadequate to store the quantity of paint normally carried on board this vessel. Thus, paint and other flammable liquids are stowed in the fan rooms and other inappropriate spaces inside the ship.
- Each stateroom is presently outfitted with an overstuffed chair and a portable refrigerator. These items represent an unusual fire hazard and a significant ignition hazard; however, they were not accounted for in the fire safety analysis due to the YARD's plans to remove these items from the vessel as part of the conversion.
- Nylon carpets, instead of approved wool carpets, are presently installed in all staterooms. Nylon represents a significant fire hazard compared to wool; however, the YARD also plans to remove this carpet during the conversion.

The compartmentation drawings were reviewed to determine if adequate means of egress exist for crew members to escape from a fire and to assess the ability of the crew to access each compartment for the purpose of firefighting. The proposed compartmentation appears to be quite adequate to permit egress from all normally occupied spaces. It also appears that there is adequate access for firefighting to all compartments where a potential fire could occur.

The fire prevention phase also includes first aid or the initial attempts to extinguish a fire after ignition occurs but before the fire grows substantially beyond the point described as EB. First aid primarily involves an analysis of the type, quantity, and location of portable extinguishers. The existing dry chemical portable fire extinguishers have been removed by the YARD. It is unknown if the YARD will reinstall these extinguishers since they are not PKP type

extinguishers which are the only authorized portable dry chemical extinguishers permitted on Coast Guard cutters [5]. The proposed locations of portable extinguishers in the vicinity of the new compartmentation is also unknown.

3.1.2. DETECTION

The 225' VINDICATOR will have a crew of 35 persons compared with the existing 210' WMEC, for example, which has a crew of 68, or the 270' WMEC which has a crew of 100. It is apparent that due to the greatly reduced crew complement, the installation and operation of a sophisticated and comprehensive automatic fire detection system is vitally important. The presently installed fire detection system is not considered adequate since it primarily serves the engineering spaces on the ship. The present fire detection system does not monitor berthing areas, staterooms or passageways as required by the Naval Engineering Manual [5]. There are small commercial type battery-powered smoke detectors installed in several locations such as passageways and ladders. These detectors appear to have been hastily installed by the crew and are not in accordance with a well-engineered fire detection system which should be designed to compensate for the small crew size on VINDICATOR. The ship appears to have adequate means to notify the Bridge of a fire via internal communication systems such as sound powered and dial telephones. In addition there are five manual fire alarm stations in strategic locations throughout the ship.

3.1.3. CONTAINMENT

The ship visit and a review of the available documentation revealed the existence of the following problems which may contribute to an inability to contain the fire to a room of origin or enhance its ability to spread:

- The existing compartmentation and access fittings such as watertight doors, hatches, and windows are not presently numbered or classified for damage control purposes in accordance with the requirements of the Naval Ships Technical Manual. [1] This problem could result in delays or confusion reporting the location of, and responding to, a fire. Recommendations for renumbering the compartmentation and accesses were provided in the interim report for this project [19]. These results are also documented in Appendix A of this report.
- Compartment check-off lists are non-existent. These lists serve a useful purpose to quickly point out the existence and location of vital damage control items such as isolation valves and portable fire extinguishers used to contain a fire.
- The existing joiner doors to staterooms, offices, lounge spaces, mess decks, and ladders presently have automatic door closers installed which ensure the door will be normally closed in the event of a fire. This feature is presently being defeated in several cases where doors are held open by tying them with line to the associated bulkhead. This problem slows, if not prevents, the closing of the door to prevent the spread of fire.
- Remote shutdowns for diesel engines do not exist. The diesels are shut down electrically in conjunction with activating the discharge of an installed Halon system for the affected space.
- All weather doors are presently locked closed to prevent vandalism and theft. If not corrected this will prevent egress for crewmembers to escape from a fire and slows or prevents access

by firefighters. It is presumed that this condition will not exist at-sea and in-port as a WMEC but it presently exists in the in-storage scenario at the YARD.

- The Main Deck and 01 Deck have extremely long longitudinal passageways. These passageways do not have joiner doors or smoke curtains installed in strategic locations to prevent the passage of smoke and flame.
- The celotex dropped ceilings installed on the Main Deck, 01 Deck and 02 Decks are installed in a light steel framework. It is apparent that this framework is not designed to resist distortion in a fire. Therefore it is likely that the celotex panels will fall out of the framework early in a fire and permit the fire to enter the void space above and thus easily spread to adjacent spaces since there are relatively few fire breaks in these void spaces.

3.1.4. EXTINGUISHMENT

The YARD has removed most of the portable fire extinguishers and most of the fire hoses from the fire main stations, apparently to prevent loss during the conversion project. It is presumed, but unknown, if adequate quantities and lengths of fire hoses and portable firefighting extinguishers will be reinstalled in appropriate locations throughout the vessel after the conversion is completed.

It was noted during the ship visit that each major engineering space and every stateroom and berthing area was equipped with containers for emergency escape breathing devices (EEBDs). The YARD has removed the EEBDs from the VINDICATOR and it is unknown but presumed that the converted WMEC will be outfitted with appropriate quantities of EEBDs in strategic locations.

3.1.5. POTENTIAL LOCATION OF ADDITIONAL REPAIR LOCKER

The VINDICATOR presently has one Repair Locker located on the Main Deck, frame 61 starboard side, accessible from the Main Deck Passageway. Considering the planned size of the crew, there is an insufficient number of available personnel to populate two repair parties simultaneously. Due to the size of the ship however, it would be desirable to have two repair lockers. The planned compartmentation was studied for potential locations of a second repair locker. It would be ideal if this additional repair locker could be located on the 01 Deck forward of amidships since the existing repair locker is located on the Main Deck aft of amidships. This would facilitate the repair party to rapidly respond to fires from the repair locker closest to the fire. Outfitting both repair lockers with a full allowance of damage control gear would also ensure an adequate quantity of firefighting equipment was available in the event one repair locker is rendered inaccessible due to the fire. Possible locations that should be considered include modifying existing compartment 01-30-1-L to incorporate a repair locker accessible from the 01 Deck passageway. Modifying other staterooms forward of amidships on the 01 Deck are also potential sites for the second repair locker. A repair locker in this general area would facilitate a rapid response to the Emergency Switchboard and Generator Space on the 01 Deck forward as well as other spaces on the 01 Deck and above.

3.1.6. IN-STORAGE AT THE COAST GUARD YARD

Normally, military ships are either at-sea with a full crew complement or in-port with a full in-port duty section on board. The duty section includes qualified and trained personnel to handle fire and flooding as well as any other foreseeable casualty a ship may experience. Consequently, the baseline fire safety analysis and the fire protection doctrine assume these "normal" conditions exist. A decision has been made recently to leave the VINDICATOR in-storage at the Coast Guard YARD for up to two years in a decommissioned, unmanned status. The prevailing conditions noted during the ship visit that will be in effect during the period the ship will be in-storage potentially affect the fire safety of the ship. Therefore an "in-storage" scenario was studied as part of the detailed fire safety analysis discussed in the next section of this report.

3.1.7. HISTORICAL RECORDS OF FIRES ON MEDIUM ENDURANCE CUTTERS

The Coast Guard MISREP database was researched for historical records of reported fires on all Medium Endurance Cutters during the period FY88 through FY92. There are 34 Medium Endurance Cutters (WMECs), not counting the T-AGOS class vessels as shown in Table 3.1. The number of cutter-years of data is reduced slightly due to the fact the last three 270' "BEAR" class cutters were delivered to the Coast Guard after October 1988. This table also shows the number of reported fires for each of these cutter classes. **There were 13 reported fires in 134 cutter-years of data, therefore based on statistics it may be concluded that a Medium Endurance Cutter will experience a reportable fire once every 10.3 years**. Of these 13 fires, five were class A, four were class B and four were class C. Eleven of these fires were contained and extinguished within the room of origin and two spread to involve multiple compartments. Therefore fires that spread beyond the room of origin can be expected to occur on a WMEC once every 67 years, or the fleet of 34 existing WMECs can expect a multiple room fire once every two years.

Table 3.1 Historical Records of Reported Fires in WMECs

Class of WMEC	Number of Cutters in Class	Number of Cutter-Years	Number of Reported Fires	Class A Fires	Class B Fires	Class C Fires
270'	13	50	3	1	2	0
213'	3	12	2	1	0	1
210'	16	64	6	2	2	2
205'	1	4	1	1	0	0
180'	1	4	1	0	0	1
Totals	**34**	**134**	**13**	**5**	**4**	**4**

3.2. DETAILED FIRE SAFETY ANALYSIS USING SFSEM/SAFE

The SFSEM was used to conduct a nine step fire safety analysis on the VINDICATOR. The following sections discuss each of these steps in sequence.

3.2.1. LOAD DATABASE WITH SHIP'S GEOMETRY

The proposed compartmentation was modeled in AutoCAD and the pre-printed ship visit forms were produced. A preliminary review of the drawings provided showed six levels, two below and three above the Main Deck. During the ship visit it was discovered that two foot high utility void spaces existed above all compartments on the Main Deck, 01 Deck and 02 Deck. Furthermore, since the joiner bulkheads that define compartments on these decks are not carried to the deck above, the compartmentation in the void spaces is considerably different than the spaces below. To properly model this configuration, the utility spaces were treated as additional deck levels. This expanded the number of deck levels to nine, which is the current limitation in SAFE. Coupled with the fact there are 170 compartments (modeled in AutoCAD) in this ship, computer times necessary to run the probabilistic model in SAFE was noticeably longer than experienced in previous analyses. There was a concern that the number of potential fire paths that may be generated could exceed the memory available in the hardware used to run SAFE. This, in fact, occurred on several runs of the model using a DOS-based computer with eight megabytes of RAM. The same model run was successful on a 16 megabyte RAM computer. Thus, nine levels and 170 compartments appears to be close to the limit for the existing hardware. Information concerning the compartmentation including deck area and compartment height is tabulated in Appendix B.1.

3.2.2. CONDUCT SHIP VISIT

The primary purpose of the ship visit is to collect information necessary to perform a fire safety analysis using the SFSEM/SAFE. There are two types of information collected - factual and judgmental. Since the VINDICATOR is in the process of being converted from a T-AGOS class vessel to a WMEC, some of the factual information was taken from conversion specifications and associated drawings. In addition, some assumptions about the relocation or reinstallation of certain firefighting and personnel protective equipment were necessary to complete the ship visit forms. Judgmental information includes parameters requiring engineering judgment such as the assignment of probabilistic values for flame termination and barrier failure. Furthermore, some factual information such as fuel loads had to be estimated using engineering judgment.

Input data required to perform the fire safety analysis and develop the fire protection doctrine for the VINDICATOR are documented in Appendix B. **It is presumed that the VINDICATOR will be in compliance with the Naval Engineering Manual [5] and other applicable regulations such as the Naval Ships Technical Manuals [1, 6] following conversion to a WMEC, even though the conversion specifications may be silent on some issues**. Assumptions concerning input data are documented in Appendix B, some of the key assumptions are:

- PKP portable dry chemical fire extinguishers will be installed throughout the ship as required by applicable regulations.

- Compartments and accesses such as doors, scuttles, and hatches will be labeled with accurate deck, frame and item number.
- Accesses, valves, and other damage control devices will be labeled with their appropriate damage control classification (XRAY, YOKE, ZEBRA, etc.).
- Compartment check-off lists will be developed and posted in each compartment.
- Repair Locker(s) will be outfitted with the full allowance for damage control gear appropriate for a WMEC [20].

The engineer/analysts use engineering judgment to develop the probabilistic values entered into SAFE. In previous analyses, probabilistic values were assigned on a compartment basis with frequent referral to previously assigned values on other ships to ensure consistency. This approach was deemed impractical on the VINDICATOR due to the large number of compartments. A new approach was developed which relies on default values. The default values were determined by reviewing all previously assigned values on the ten classes of small cutters analyzed in the Small Cutter Fire Protection project. Where applicable, values such as fuel load densities were assigned on a "per square foot" basis. In this manner, values are scaled appropriately. Default values were developed for fuel loads, and flame limitation (I, A, and M values). Defaults were assigned on a "compartment use indicator" basis.

3.2.3. LOAD SAFE INPUT VALUES

Fire Safety Objectives (FSOs), probabilities of flame termination and barrier failure, and fuel loads in each compartment are the key values the analyst determines based on engineering judgment.

There were three barriers noted on the VINDICATOR that were not in the existing catalog of barrier materials in the SFSEM database. These included the marine plywood, celotex ceiling panels and the fiberglass toilet/shower units. A curve for both the probability of thermal failure and the probability of durability failure versus heat energy impact was developed for each of these materials and added to the catalog. Values for thermal properties such as thermal conductivity, specific heat and density were determined from handbooks. Certain other barrier materials, such as the decorative joiner work to be installed as non-structural interior partitions in new compartments were unknown at this stage of the conversion project. In these cases, engineering judgment was used to select an appropriate barrier material from the existing catalog of barrier materials in the SFSEM database. The catalog of barrier materials and their thermal properties used for the VINDICATOR are tabulated in Attachment B.2.1 in Appendix B.2. Assignment of barrier materials and their associated T-adjust and D-adjust values for each compartment are shown in Table B.2.1 in Appendix B.2.

Fuel loads for each compartment are tabulated and documented in Appendix B.7. These values are either the default value or a tailored value if the contents of a compartment in the VINDICATOR differed from those typically encountered during the Small Cutter Fire Protection project (SCFP). Fire growth models were determined by engineering judgment taking into account the predominant type, quantity and distribution of fuel packages. The fire growth models determine pre-FRI fire growth rates (alpha) and the maximum heat release rate (Qmax) for the

combustible contents of each compartment. These values are documented in Appendix B.8 for each compartment.

Default values for the probabilities of flame limitation due to self termination (I values), automated fire protection systems (A values) and manual suppression (M values) given EB were determined using the spreadsheets shown in Tables 3.2 - 3.4 which document the various factors used in the calculations. Formulas for the calculations used in these spreadsheets are described in the Theoretical Basis of the SFSEM [2]. The formulas for calculating the probabilities of flame termination given Tbar or given Dbar are also described in the Theoretical Basis of the SFSEM [2]. The assigned/calculated probabilities for self termination, automated suppression and manual suppression for each compartment on the VINDICATOR are tabulated in Table B.6.1 in Appendix B.6. Some of the default values shown in Tables 3.2 - 3.4 were changed to reflect conditions in a particular compartment that differed from conditions assumed in the development of the default values. It should also be noted that the existing CO_2 flooding systems for each main propulsion motor are not considered in calculating the "A" values for the Motor Room compartment. These systems are designed to discharge CO_2 directly into the affected motor casing and will not have any beneficial effect on fighting a fire in the Motor Room compartment.

The FSOs for the VINDICATOR were established by the engineer/analysts conducting the fire safety analysis following the approach described in section 2.2.2. of this report and documented in Table B.3.1 in Appendix B.3. The FSOs established for the VINDICATOR are consistent with those established for the ten classes of small Coast Guard Cutters previously analyzed. Approval of this report by Coast Guard cognizant authorities, implies approval of the FSOs established for this class of cutter.

Table 3.2 Default Values for Self-Termination

CUI	CUI DESCRIPTION	FGM	FGM (Fire Growth Model) Description	Insul. Bulkhds	Insul. Overhd	Light Fixtrs	Potential Fuel Loads: Elect. Cabl.	Elect. Dev.	Switch boards	Flamm Liq.	Furn.	Clthng Bedd.	Bulkhd Cover.	Deck Cvr.	Other Fuel
K	HAZ. MATL. STORAGE	5	UNSTACKED CELL & PLASTICS			X	X			X					
QL	LAUNDRY	12	HANGING CELLULOSICS	X	X	X	X	X				X		X	
AG	GEAR LOCKER	1	STACKED WOOD PALLETS			X	X			X					PFD/Linens
QO	OFFICE SPACES	8	OFFICE SPACES	X	X	X	X	X		X	X		X	X	Computers
TU	STACKS/ENGINE UPTAKES	13	GREASY, SOOTY SPACES				X								Exhaust
AS	STOREROOM	3	STACKED PLASTIC IN CARTONS			X	X			X					
C	ENG. CONTROL/COMM.	7	POLY WIRE INSUL. /POLYSYN.	X	X	X	X	X	X		X		X	X	Console
LL	WARDROOM/MESS/LOUNGE	9	LOUNGE SPACES	X	X	X	X	X			X		X	X	TV/VCR
L5	CREWS BERTHING	10	BERTHING AREAS	X	X	X	X	X			X	X	X	X	
EE	MAIN PROP.-ELEC.	13	GREASY, SOOTY SPACES			X	X	X	X						
EM	MAIN PROP.-MECH.	13	GREASY, SOOTY SPACES			X	X	X	X	X					Engines
QE	EMERGENCY GEN. SPACES	13	GREASY, SOOTY SPACES			X	X	X	X	X					Engines
QS	SHOPS	6	PAPER FILLED POLY LETTER TRAYS			X	X	X	X	X					
QW	WET & DRY LABS	7	POLY WIRE INSUL. /POLYSYN.			X	X	X		X			X	X	
LM	MEDICAL/DENTAL SPACE	9	LOUNGE SPACES	X	X	X	X			X	X	X	X	X	
L1	SENIOR OFF. CABIN	10	BERTHING AREAS	X	X	X	X	X			X	X	X	X	TV/VCR
L2	OFF./CPO QTRS.	10	BERTHING AREAS	X	X	X	X	X			X	X	X	X	TV/VCR
QA	AUX. MACH. SPACES	13	GREASY, SOOTY SPACES			X	X	X	X						
AA	CARGO HOLD	5	UNSTACKED CELLULO. & PLASTICS			X	X	X							
AR	REFRIG. STORAGE	16	VERY LOW DENSITY STORAGE	X	X	X	X	X							Food Pkgs.
C	SHIP CONTROL-PILOTHOUSE	8	OFFICE SPACES	X	X	X	X	X	X		X		X	X	Console
QG	GALLEY	13	GREASY, SOOTY SPACES	X	X	X	X	X		X					Fat Fryer
QG	SCULLERY	5	UNSTACKED CELL & PLASTICS	X	X	X	X	X	X						
QF	FAN ROOM	5	UNSTACKED CELL & PLASTICS			X	X	X	X						
LP	PASSAGEWAYS/VESTIBULES	15	PASSAGEWAYS	X	X	X	X		X					X	Fire Main St.
LW	SANITARY SPACES	16	VERY LOW DENSITY STORAGE	X	X	X	X	X					X	X	Shwr Encl
LP	STAIRCASES	14	STAIRWAYS	X	X	X	X							X	
TH	TRUNK/HOIST/DUMBWAITERS	16	VERY LOW DENSITY STORAGE				X	X							
V	VOIDS	16	VERY LOW DENSITY STORAGE												
W	WATER TANKS	16	VERY LOW DENSITY STORAGE												
F	FUEL/LUBE/DIRTY OIL	NA	NA												
J	JP-5 FUEL	NA	NA												
M	EXPLOSIVES	NA	NA												
QH	HELICOPTER HANGER	NA	NA												

Table 3.2 Default Values for Self-Termination (continued)

									Ignition Source Likelihood				
			FGM (Fire Growth Model)	FRI Time	Bulkhead	Overhead	Corner	Center	Iebar|EB	Icbar|EB	Irbar|EB	Ibar EB	I|EB
CUI	CUI DESCRIPTION	FGM	Description	(min)	EB	EB	EB	EB	Bulkhead	Ceiling	Room		
K	HAZ. MATL. STORAGE	5	UNSTACKED CELL & PLASTICS	2		1			90	95	98	84	16
QL	LAUNDRY	12	HANGING CELLULOSICS	4	1	2			85	95	98	79	21
AG	GEAR LOCKER	1	STACKED WOOD PALLETS	5		1			90	90	90	73	27
QO	OFFICE SPACES	8	OFFICE SPACES	3	1	2			80	90	95	68	32
TU	STACKS/ENGINE UPTAKES	13	GREASY, SOOTY SPACES	2		1		1	80	90	95	68	32
AS	STOREROOM	3	STACKED PLASTIC IN CARTONS	3		1			80	90	85	61	39
C	ENGINE CNTRL/COMM.	7	POLY WIRE INSUL. /POLYSYNTHE.	3	1	2			90	85	80	61	39
LL	WARDROOM/MESS/LOUNGE	9	LOUNGE SPACES	6	1	2			75	85	95	61	39
L5	CREWS BERTHING	10	BERTHING AREAS	3		1			80	90	80	58	42
EE	MAIN PROP.-ELEC.	13	GREASY, SOOTY SPACES	2	1	3		2	70	85	95	57	43
EM	MAIN PROP.-MECH.	13	GREASY, SOOTY SPACES	2	2	3		1	70	85	95	57	43
QE	EMERGENCY GEN. SPACES	13	GREASY, SOOTY SPACES	2	2	3		1	70	85	95	57	43
QS	SHOPS	6	PAPER FILLED POLY LETTER TRAYS	4	1	3		2	70	85	95	57	43
QW	WET & DRY LABS	7	POLY WIRE INSUL. /POLYSYNTHE.	5		2		1	70	85	95	57	43
LM	MEDICAL/DENTAL SPACE	9	LOUNGE SPACES	4	2	1			80	90	75	54	46
L1	SENIOR OFF. CABIN	10	BERTHING AREAS	3	1	2			80	80	80	51	49
L2	OFF./CPO QTRS.	10	BERTHING AREAS	3	1	2			80	80	80	51	49
QA	AUX. MACH. SPACES	13	GREASY, SOOTY SPACES	2	1	3		2	70	80	90	50	50
AA	CARGO HOLD	5	UNSTACKED CELLULO. & PLASTICS	5	2	1			60	70	80	34	66
AR	REFRIG. STORAGE	16	VERY LOW DENSITY STORAGE	>10		1			50	85	70	30	70
C	SHIP CONTROL-PILOTHOUSE	8	OFFICE SPACES	4	1	3		2	65	65	70	30	70
QG	GALLEY	13	GREASY, SOOTY SPACES	7	1	2			65	65	65	27	73
QG	SCULLERY	5	UNSTACKED CELL & PLASTICS	3	2	3		1	65	65	65	27	73
QF	FAN ROOM	5	UNSTACKED CELL & PLASTICS	8	1	3		2	60	65	70	27	73
LP	PASSAGEWAYS/VESTIBULES	15	PASSAGEWAYS	>10	1	1			75	60	50	23	78
LW	SANITARY SPACES	16	VERY LOW DENSITY STORAGE	>10		1			50	60	70	21	79
LP	STAIRCASES	14	STAIRWAYS	>10		1			60	85	30	15	85
TH	TRNKS/HOISTS/DUMBWAITER	16	VERY LOW DENSITY STORAGE	>10				1	30	40	30	4	96
V	VOIDS	16	VERY LOW DENSITY STORAGE	>10	NA	NA	NA	NA	20	20	20	1	99
NA	WATER TANKS	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
F	FUEL/LUBE/DIRTY OIL	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
J	JP-5 FUEL	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
M	EXPLOSIVES	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
QH	HELICOPTER HANGER	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA

Ibar = Iebar * Icbar * Irbar where:

Iebar = Probability of flame reaching the enclosure point

Icbar = Probability of flame reaching the ceiling

Irbar = Probability of flame reaching full room involvement

I = 1 - Ibar

Table 3.3 Default Values for Automated Suppression

TYPICAL COMPARTMENT DEFAULT VALUES

Shaded columns are calculated

CUI	FGM		dan	nan	san	An|EB	dapf	sapf	capf	fap	dapv	sapv	capv	vap	dapp	sapp	capp	pap	Ap|EB	saa	aaa	daa	Aa|EB	qae	cae	bae	Ae|EB	A|EB
EM	13	AFFF	0.95	0.99	0.99	0.93	1.00	0.95	1.00	0.95	1.00	0.90	1.00	0.90	1.00	1.00	1.00	1.00	0.86	0.90	0.90	0.90	0.73	1.00	1.00	0.85	0.85	0.49
EE	13	CO2	0.95	0.99	0.99	0.93	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.90	1.00	0.95	1.00	0.95	0.86	0.99	0.95	0.90	0.85	1.00	1.00	0.90	0.90	0.61
EM	13	CO2	0.95	0.99	0.99	0.93	1.00	0.95	1.00	0.95	1.00	0.90	1.00	0.90	1.00	1.00	1.00	1.00	0.86	0.99	0.95	0.90	0.85	1.00	1.00	0.90	0.90	0.61
QE	13	CO2	0.95	0.99	0.99	0.93	1.00	0.95	1.00	0.95	1.00	0.90	1.00	0.90	1.00	1.00	1.00	1.00	0.86	0.99	0.95	0.90	0.85	1.00	1.00	0.90	0.90	0.61
EM	13	Halon-1	0.95	0.99	0.99	0.93	1.00	0.95	1.00	0.95	1.00	0.90	1.00	0.90	1.00	1.00	1.00	1.00	0.86	0.99	0.99	0.90	0.88	1.00	1.00	0.95	0.95	0.67
QE	13	Halon-1	0.95	0.99	0.99	0.93	1.00	0.95	1.00	0.95	1.00	0.90	1.00	0.90	1.00	1.00	1.00	1.00	0.86	0.99	0.99	0.90	0.88	1.00	1.00	0.95	0.95	0.67
EM	13	Halon-2	0.95	0.99	0.99	0.93	1.00	0.95	1.00	0.95	1.00	0.90	1.00	0.90	1.00	1.00	1.00	1.00	0.86	0.99	0.99	0.90	0.88	1.00	1.00	0.99	0.99	0.70
K	5	CO2	0.95	0.99	0.99	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.95	0.89	1.00	1.00	0.90	0.90	0.75
QG	13	K2CO3	0.95	0.99	0.99	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.95	0.95	0.99	0.99	0.99	0.97	1.00	1.00	0.99	0.99	0.85

An=dan*nan*san where dan=detection of fire, nan=notification of Bridge, and san=sound the alarm
Ap=fap*vap*cap where fap=secure the fuel supply, vap=secure the ventilation, and cap=secure the electrical power
fap=dapf*sapf*capf where dapf=decide to secure the fuel supply, sapf=start to secure the fuel supply, and capf=complete securing the fuel supply
vap=dapv*sapv*capv where dapv=decide to secure the ventilation, sapv=start to secure the ventilation, and capv=complete securing the ventilation
vap=dapv*sapv*capv where dapv=decide to secure the ventilation, sapv=start to secure the ventilation, and capv=complete securing the ventilation
cap=dapp*sapp*capp where dapp=decide to secure the power, sapp=start to secure the power, and capp=complete securing the power
Aa=saa*aaa*daa where saa=alignment of automated system, aaa=agent discharges from nozzle, and daa=agent discharges on fire
Ae=qae*cae*bae where qae=quantity of agent is adequate, cae=concentration of agent is adequate, and bae=blackout occurs
A=An*Ap*Aa*Ae where An=Notification, Ap=Preparation, Aa=Agent Application, and Ae=Fire Extinguishment
EE = Main Propulsion - Electrical Spaces such as Motor Rooms and Main Propulsion Generator Rooms
EM = Main Propulsion - Mechanical Spaces such as Engine Rooms (Diesel and/or Gas Turbine Engines)
K = Hazardous Material Storage such as Paint Lockers and Flammable Liquid Storage Spaces
QE = Emergency Auxiliary Generator Space such as Emergency Generator Room
QG = Galley/Pantry/Scullery
CO2 = Manually released 1-shot Carbon Dioxide total flooding system
Halon = Manually released 1 or 2 shot Halon 1301 total flooding system
K2CO3 = Manually released 1-shot Aqueous Potassium Carbonate System for Grease fires on Galley Stove/Deep Fat Fryer

Table 3.4 Default Values for Manual Suppression

CUI	CUI DESCRIPTION	FGM	FGM (Fire Growth Model) Description	FRI Time (min)	M= Prob of Man. Det. D= Installed Detector	Mn|EB	Fuel Source	Forced Vent.	Electri. Power	Mp|EB	Ma|EB	Me|EB	M|EB
TU	STACKS/ENGINE UPTAKES	13	GREASY, SOOTY SPACES	2	M=LOW	0.5	NO	YES	YES	0.7	0.2	0.9	0.06
EE	MAIN PROP.-ELEC.	13	GREASY, SOOTY SPACES	2	D=HEAT	0.9	YES	YES	YES	0.6	0.2	0.9	0.1
EM	MAIN PROP.-MECH.	13	GREASY, SOOTY SPACES	2	D=HEAT	0.9	YES	YES	YES	0.6	0.2	0.9	0.1
QE	EMERGENCY GEN. SPACES	13	GREASY, SOOTY SPACES	2	D=HEAT	0.9	YES	YES	YES	0.6	0.2	0.9	0.1
QA	AUX. MACH. SPACES	13	GREASY, SOOTY SPACES	2	M=MEDIUM	0.7	NO	NO	YES	0.8	0.2	0.9	0.1
K	HAZ. MATL. STORAGE	5	UNSTACKED CELL & PLASTICS	2	D=HEAT	0.9	NO	YES	YES	0.7	0.2	0.9	0.11
C	SHIP CONTROL-PILOTHOUSE	8	OFFICE SPACES	4	M=HIGH	0.8	YES	YES	YES	0.6	0.45	0.9	0.19
LM	MEDICAL/DENTAL SPACE	9	LOUNGE SPACES	4	M=MEDIUM	0.7	NO	YES	YES	0.7	0.45	0.9	0.2
AS	STOREROOM	3	STACKED PLASTIC IN CARTONS	3	M=MEDIUM	0.7	NO	NO	YES	0.8	0.4	0.9	0.2
QO	OFFICE SPACES	8	OFFICE SPACES	3	M=MEDIUM	0.7	NO	NO	YES	0.8	0.4	0.9	0.2
QL	LAUNDRY	12	HANGING CELLULOSICS	4	M=MEDIUM	0.7	NO	NO	YES	0.8	0.45	0.9	0.23
QG	GALLEY	13	GREASY, SOOTY SPACES	3	D=SMOKE	0.9	NO	YES	YES	0.7	0.4	0.9	0.23
L1	SENIOR OFF. CABIN	10	BERTHING AREAS	3	D=SMOKE	0.9	NO	YES	YES	0.7	0.4	0.9	0.23
L2	OFF./CPO QTRS.	10	BERTHING AREAS	3	D=SMOKE	0.9	NO	YES	YES	0.7	0.4	0.9	0.23
QS	SHOPS	6	PAPER FILLED POLY LETTER TRAYS	4	M=MEDIUM	0.7	NO	NO	YES	0.8	0.45	0.9	0.23
C	ENGINE CONTROL/COMM.	7	POLY WIRE INSUL/POLYSYNTHE.	3	M=HIGH	0.8	NO	NO	YES	0.8	0.4	0.9	0.23
AA	CARGO HOLD	5	UNSTACKED CELLULO. & PLASTICS	5	M=MEDIUM	0.7	NO	NO	YES	0.8	0.5	0.9	0.25
QW	WET & DRY LABS	7	POLY WIRE INSUL. /POLYSYNTHE.	5	M=MEDIUM	0.7	NO	NO	YES	0.8	0.5	0.9	0.25
AG	GEAR LOCKER	1	STACKED WOOD PALLETS	5	M=LOW	0.7	NO	NO	YES	0.8	0.5	0.9	0.25
L5	CREWS BERTHING	10	BERTHING AREAS	3	D=SMOKE	0.9	NO	NO	YES	0.8	0.4	0.9	0.26
QF	FAN ROOM	5	UNSTACKED CELL & PLASTICS	8	M=LOW	0.5	NO	NO	YES	0.8	0.8	0.9	0.29
LW	SANITARY SPACES	16	VERY LOW DENSITY STORAGE	>10	M=LOW	0.5	NO	YES	YES	0.7	0.9	0.95	0.3
TH	TRUNKS/HOISTS/DUMBWAITERS	16	VERY LOW DENSITY STORAGE	>10	M=LOW	0.5	NO	NO	YES	0.8	0.9	0.95	0.34
V	VOIDS	16	VERY LOW DENSITY STORAGE	>10	M=LOW	0.5	NO	NO	YES	0.8	0.9	0.95	0.34
W	WATER TANKS	16	VERY LOW DENSITY STORAGE	>10	M=LOW	0.5	NO	NO	YES	0.8	0.9	0.95	0.34
AR	REFRIG. STORAGE	16	VERY LOW DENSITY STORAGE	>10	M=LOW	0.5	NO	NO	YES	0.8	0.9	0.95	0.34
LL	WARDROOM/MESS/LOUNGE AREA	9	LOUNGE SPACES	6	M=HIGH	0.8	NO	NO	YES	0.8	0.6	0.9	0.35
QG	SCULLERY	5	UNSTACKED CELL & PLASTICS	7	M=MEDIUM	0.7	NO	NO	YES	0.8	0.7	0.9	0.35
LP	PASSAGEWAYS/VESTIBULES	15	PASSAGEWAYS	>10	M=MEDIUM	0.7	NO	NO	YES	0.8	0.9	0.95	0.48
LP	ASES	14	STAIRWAYS	>10	M=MEDIUM	0.7	NO	NO	YES	0.8	0.9	0.95	0.48
F	FUEL/LUBE/DIRTY OIL	NA	NA										
J	JP-5 FUEL	NA	NA										
M	EXPLOSIVES	NA	NA										
QH	HELICOPTER HANGER	NA	NA										

M = Mn * Mp * Ma * Me where
Mn = Probability of notification of the Bridge of a fire
Mp = Probability of securing fuel, ventilation, and electrical power
Ma = Probability of agent application before FRI occurs in the room of origin
Me = Probability that manual firefighting will extinguish the fire before FRI occurs in the room of origin

3.2.4. CALCULATE FRI TIMES AND POST-FRI HEAT RELEASE RATES

A fire growth model was selected for each compartment that most closely approximated the fuel loads noted during the ship visit based on engineering judgment and the definitions contained in Appendix C of the Theoretical Basis of the SFSEM [2]. The pre-FRI fire growth rate (alpha) used in the pre-FRI heat release rate calculation and the maximum heat release rate (Qmax) are based on the fire growth model selected. The Post-FRI heat release rates (Q) and FRI times are calculated in SAFE. All of these fire parameters are tabulated for each compartment in Appendix B.8. The algorithms for the calculations are also described in the Theoretical Basis of the SFSEM [2].

FRI time is a critically important fire parameter because it determines the length of time between EB and the development of sufficiently high compartment temperatures that full room involvement conditions is assured. When FRI is achieved, conditions in the compartment are assumed to be incapable of supporting life and the heat energy of the burning fuel is assumed to impact the barriers. Therefore, if FRI is infinite (or greater than 60 minutes for practical purposes) the fire will be limited to the compartment. On the other hand if FRI is very short (for example, two or three minutes) there is little chance that the fire party can respond quickly enough to extinguish the fire in the compartment. A review of the calculated FRI times for all compartments showed expected results with very few exceptions. FRI times were adjusted based on engineering judgment in seven of the 170 compartments in the VINDICATOR as described in the following paragraphs.

The FRI times in all the fiberglass toilet/shower compartments was one minute. This was expected due to the exceedingly high fuel loads and very fast fire growth rate of fiberglass. Normally FRI times in sanitary spaces are infinite. Since sanitary spaces are assigned a MAL of 4 (CBO acceptable) the probable loss of these fiberglass toilet/shower units in a fire path is not calculated as a relative loss factor (RLF). RLFs are only calculated for compartments with a MAL rating of 1, 2 or 3. This subject was studied further as discussed in the "analysis of alternatives", section 3.2.7 of this report.

The long passageways on the Main Deck and 01 Deck were divided into multiple compartments connected by zero strength barriers for modeling purposes. The FRI times were adjusted in an individual segment if it was significantly different than other segments.

The large utility spaces were very similar in terms of fuel loading and available ventilation. It was estimated that fuel load density was approximately equal for these spaces. The FRI times therefore should also be similar within an order of magnitude. Other factors affect FRI times so an exact match was not expected. FRI times were adjusted for one utility space to ensure consistency.

FRI times in compartments 1-40-2-A, 1-40-6-A and 2-24-1A-Q were also adjusted due to unexpected results considering their fuel loads. The FRI times were adjusted based on engineering judgment and a thorough review of FRI times for similar spaces calculated in the ten ships previously analyzed in the SCFP.

3.2.5. RUN PROBABILISTIC MODEL

The individual target option was specified as an output option for running the probabilistic model in the fire safety analyses of the ten cutters considered in the SCFP as well as the VINDICATOR. This option permits a rapid comparison of each compartment as a target compartment compared to pre-established fire safety objectives for fires that may originate in any compartment. In other words it provides a means to identify "victims" of fires that may start in any compartment (including the target) and ultimately involve the target compartment. It does not, however, provide a great deal of insight into the primary sources of fires that ultimately result in the loss of target compartments. Furthermore, a careful review of the results revealed that the target compartments with the highest RLFs (most frequently lost compared to FSOs) were not the engineering spaces which have the highest frequency of EB. This result seemed counter-intuitive and prompted a thorough review of the algorithm associated with this output option in SAFE.

The review of the Individual Target Option revealed that the algorithm requires independent fire paths to accurately accumulate results for the calculation of RLFs. The methodology, however, models the real world which, in general, does not produce independent fire paths. Thus, the algorithm calculates conservative albeit imprecise RLFs. Results are more accurate for engineering spaces and less accurate for other spaces causing them to have higher-than-actual RLFs (less fire safe). Since these results do not lend any insight into the primary sources of fires, the probabilistic model was also run specifying the Barrier Option to obtain information relative to sources of fires. Results of the baseline fire safety analysis with the barrier option run on the baseline data set is documented in Appendix C, Table C.2.4. These results indicate that engineering spaces dominate as the most likely sources of all fires on the VINDICATOR. The complete results of running the probabilistic model on the baseline data set with the individual target option and barrier option are shown in Appendix C.

3.2.6. ANALYZE BASELINE RESULTS

The complete baseline results for the VINDICATOR are documented in Appendix C, Tables C.2.1 - C.2.3, for the three standard and nine non-standard scenarios. An excerpt from these complete results shown in Tables 3.5 and 3.6 list only compartments with RLFs greater than or equal to 0.10 and a MAL of 1 - 3 for selected scenarios. These two tables summarize the most interesting results of the baseline analysis. The RLFs shown in Table 3.5 for the two in port scenarios (XRAY and YOKE) are extremely similar. This indicates that there are relatively few doors, scuttles and hatches labeled YOKE. A review of the access classifications reveal that there are only five doors and hatches labeled YOKE (there are three labeled XRAY and 41 labeled ZEBRA). Three of these five are to weather (which does not contribute to fire spread) and the other two connect the Thaw Room to the Freeze Room and the Thaw Room to the Chill Room. Since there is relatively little fuel load in refrigerated storage spaces there is little likelihood that these doors contribute to fire spread either. Thus little difference between the two in port scenarios is to be expected.

The two YOKE scenarios, in port and at sea (scenarios 2 and 3) normally differ slightly due to the difference in the percent (time) monitored for each compartment. In general, it is more likely that a crew member will discover a fire earlier at sea than in port due to the higher manning levels at sea than in port over a 24 hour period. Therefore, lower RLFs (safer ship) are normally expected for at sea scenarios than in port scenarios. However, the percent time monitored is

frequently driven by the presence of installed fire detectors. If a fire detector is present, the percent monitored is set to 95% for both inport and at sea conditions (less than 100% to account for the reliability of the instrument). Therefore, if a comprehensive fire detection system is installed that monitors most compartments, very little or no difference is expected in RLFs between the two YOKE scenarios (in port and at sea). In the VINDICATOR, there are fire detectors in many of the engineering spaces as shown in Table B.4.1 in Appendix B.4, however the crew must presently detect fires in most staterooms and passageways and many other spaces on this ship. The percent monitored values for most compartments are thus set lower in port than at sea unless a fire detector is present when the values are set to 95%. The differences in baseline results between at sea and in port YOKE scenarios for the VINDICATOR shown in Table 3.5 are relatively minor due to the fact that percent monitored values do not differ greatly and many spaces are protected by a fire detector. The fact that RLFs in the at sea YOKE scenario are slightly higher for some compartments than the in port YOKE scenario is due to the fact that five compartments are occupied more frequently in port than at sea.

It could be argued that "M" values should be different between in port and at sea scenarios which would translate to a difference in RLFs for the baseline fire safety analysis. However, "M" values are established presuming a full repair party is available at sea and in port to respond to a fire. This further presumes the in port fire scenario occurs during normal working hours when the full crew is available, thus little or no difference in "M" values is warranted. If there is a special concern about other in port scenarios, a particular scenario can be studied as an alternative. The VINDICATOR will be in storage at the YARD for two years in an unmanned decommissioned status. Therefore, this scenario was studied as an alternative and discussed in the next section of this report.

Table 3.6 compares varying levels of fire protection for the in port, XRAY scenario. As expected, the RLFs increase with decreasing levels of fire protection. The results also show that the rank ordering of compartments from most dangerous (highest RLF) to safest (lowest RLF) is approximately the same among the four scenarios. **A thorough review of the baseline fire safety analysis results clearly shows that with passive (I), automated (A), and manual (M) fire protection in effect, all compartments in the VINDICATOR exceed FSOs by a substantial margin**. This means that no improvements are necessarily required to bring the VINDICATOR up to minimally acceptable fire safety levels. As shown in Table 3.6, all compartments meet FSOs with just I and A in effect and with just I and M in effect as well. Four compartments fail to meet FSOs and 1 compartment is marginally acceptable with just passive fire protection in effect. Therefore it is clear that either automated or manual fire suppression is required to augment the passive fire protection in order for the VINDICATOR to meet fire safety objectives. Since the ship <u>does</u> meet FSOs without considering the contribution provided by automated fire suppression, Halon 1301 total flooding systems may be considered over-protection. However, in view of the fact that this ship will be minimally manned and the present fire detection system does not monitor every space, it is reasonable to study this issue in more detail. The effect on fire safety of removing Halon 1301 from the VINDICATOR was studied as an alternative and is discussed in more detail in the next section of this report.

Table 3.5 Baseline Fire Safety Analysis Results - Scenarios 1-3

		Run No.	3-28	3-32	3-36
		Scenario	1	2	3
		Configuration	XRAY	YOKE	YOKE
		Location	In Port	In Port	At Sea
		Fire Prot Level	I,A,M	I,A,M	I,A,M
Plan ID	**Compartment Name**	**CUI**	**RLF**	**RLF**	**RLF**
1-34-2-Q	FAN ROOM	QF	0.22	0.22	0.23
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.22	0.23
1-44-2-Q	SCULLERY	QG	0.19	0.19	0.20
02-42-1-Q	FAN RM	QF	0.18	0.18	0.18
1-40-4-T	UPTAKE	TU	0.17	0.17	0.18
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.14	0.14
1-40-1-T	UPTAKE	TU	0.13	0.13	0.14
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.13	0.13
1-52-1-L	CREWS MESSROOM	LL	0.13	0.13	0.13
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.12	0.12
1-42-1-Q	GALLEY	QG	0.10	0.10	0.10

Table 3.6 Baseline Fire Safety Analysis Results - Scenarios 1,4,7 & 10

		Run No.	3-28	3-29	3-30	3-31
		Scenario	1	4	7	10
		Configuration	XRAY	XRAY	XRAY	XRAY
		Location	In Port	In Port	In Port	In Port
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	**Compartment Name**	**CUI**	**RLF**	**RLF**	**RLF**	
1-34-2-Q	FAN ROOM	QF	0.22	0.47	0.55	1.15
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.35	0.56	0.83
1-44-2-Q	SCULLERY	QG	0.19	0.37	0.43	0.79
02-42-1-Q	FAN RM	QF	0.18	0.40	0.38	0.74
1-40-4-T	UPTAKE	TU	0.17	0.26	0.35	0.51
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.26	0.34	0.61
1-40-1-T	UPTAKE	TU	0.13	0.21	0.32	0.48
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.21	0.29	0.49
1-52-1-L	CREWS MESSROOM	LL	0.13	0.38	0.43	1.10
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.13	0.36	0.40
1-42-1-Q	GALLEY	QG	0.10	0.17	0.64	1.13
03-15-0-C	PILOT HOUSE	C		0.28	0.20	1.05
01-6-0-Q	EMER SWBD & GEN RM	QE		0.19	0.34	0.80
01-54-1-C	COMMUNICATION CTR	C		0.13	0.04	0.98
2-29-1-Q	SEWAGE MCHRY RM	QA		0.11	0.16	0.21
3-52-01-E	PROPULSION MTR RM	EE			0.13	0.29
01-2-1-A	STRM NO 1	AS				0.16
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF				0.22

3.2.7. ANALYZE FIRE PROTECTION ALTERNATIVES

The baseline analysis is designed to identify compartments which fail to meet FSOs (or substantially exceed FSOs) so that attention can be focused on these compartments. Ideally, multiple hypothetical alternatives are identified and studied that improve the fire safety to minimally acceptable levels. A cost-benefit analysis, can then be conducted to form the basis for recommendations. Since the VINDICATOR already exceeds FSOs in all compartments, it was decided that certain fire safety issues/design features would be studied as "alternatives". The following alternatives were evaluated in this phase of the analysis and discussed in the next section of this report:

- Eliminate Halon 1301 total flooding systems
- Smoke hazard of fiberglass toilet/shower units
- "In-Storage" scenario at the YARD
- Flammable liquid line rupture scenario

3.2.7.1. Eliminate Halon 1301 Total Flooding Systems

A review of the baseline fire safety analysis results shown in Tables 3.5 and 3.6 as well as Appendix C clearly indicate that all compartments exceed FSOs by a substantial margin both in port and at sea and with the ship in material condition XRAY or YOKE. Consequently, it is appropriate to consider whether the ship is "over-protected". The Coast Guard pays a direct price for fire protection in terms of dollars for installation and maintenance, but it also pays an indirect price in some cases. For example, Halon 1301 is believed to cause severe environmental damage if released into the atmosphere. Since the VINDICATOR is equipped with six independent Halon 1301 total flooding systems, it is worthwhile considering the effect on fire safety of removing or replacing this agent. As shown in Table 3.7 the "alternative" of removing Halon can easily be studied by turning off the contribution to fire safety provided by the ship's automated systems. Results for these scenarios show that while RLFs definitely increase compared to the baseline (scenarios 1-3 shown in Table 3.5), all compartments continue to exceed FSOs. A recommendation to remove the Halon 1301 total flooding systems therefore may be justified from a flame movement point of view. Other factors such as the minimal manning of this ship may influence the ultimate decision. For example as discussed in section 3.2.6 above, contributions from either "A" or "M" are required to augment I values to achieve FSOs. If the Halon systems were to be removed the manual firefighting efforts of the crew would have to be relied upon to ensure overall ship fire safety.

Substituting CO_2 for Halon 1301 would continue to provide the benefit of automated systems while eliminating the adverse effect of environmental damage caused by Halon. CO_2 however, is lethal in concentrations required for total flooding systems, thus there is significant concern for life safety. On the other hand, the compartments where these systems are installed are not normally manned which mitigates the concern somewhat. In general, removing Halon 1301 systems which increases reliance on the crew for manual firefighting is considered equivalent to substituting CO_2 for Halon 1301 in terms of life safety concerns.

Table 3.7 Effect of Removing Halon 1301 Automated Fire Protection Systems

		Run No.	3-30	3-34	3-38
		Scenario	7	8	9
		Configuration	XRAY	YOKE	YOKE
		Location	In Port	In Port	At Sea
		Fire Prot Level	I,M	I,M	I,M
Plan ID	Compartment Name	CUI	RLF	RLF	RLF
1-34-2-Q	FAN ROOM	QF	0.55	0.55	0.55
3-34-0-E	MAIN GENERATOR RM	EM	0.56	0.56	0.57
1-44-2-Q	SCULLERY	QG	0.43	0.43	0.43
02-42-1-Q	FAN RM	QF	0.38	0.38	0.39
1-40-4-T	UPTAKE	TU	0.35	0.35	0.35
2-52-0-C	MAIN CONTROL STATION	C	0.34	0.34	0.34
1-40-1-T	UPTAKE	TU	0.32	0.32	0.33
2-24-4-Q	A/C MCHRY SPACE	QA	0.29	0.29	0.29
1-52-1-L	CREWS MESSROOM	LL	0.43	0.43	0.43
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.36	0.36	0.36
1-42-1-Q	GALLEY	QG	0.64	0.64	0.64
03-15-0-C	PILOT HOUSE	C	0.20	0.20	0.20
01-6-0-Q	EMER SWBD & GEN RM	QE	0.34	0.33	0.33
2-29-1-Q	SEWAGE MCHRY RM	QA	0.16	0.16	0.16
3-52-01-E	PROPULSION MTR RM	EE	0.13	0.13	0.14

3.2.7.2.Smoke Hazard of Fiberglass Toilet/Shower Units

Sanitary spaces are normally assigned a MAL rating of 4 (compartment burnout acceptable) since the loss of any one sanitary space would not affect the ship's mission. Moreover, the contents in these spaces is not considered extraordinarily valuable compared to other compartments. Finally the fuel load is usually so sparse that generation of smoke is not a life safety concern. The toilet/shower units on the VINDICATOR, however, are constructed entirely of fiberglass which typically burns vigorously and produces copious quantities of dense toxic smoke. Since the toilet/shower compartments were assigned a MAL rating of 4 in the baseline data set, their potential loss in a fire would not be calculated as a loss because CBO is considered acceptable. In order to evaluate the potential involvement of these compartments, the magnitude of acceptable loss (MAL) rating was changed to 2 (EB acceptable, FRI not acceptable). If the toilet/shower units are considered a severe threat to life safety, this MAL rating would be quite appropriate. The frequency of acceptable loss was left unchanged.

Running the probabilistic model with the baseline data set altered such that the MAL of compartments containing fiberglass toilet/shower units was changed from 4 to 2 provides visibility of the frequency these compartments may be involved in a fire. Results shown in Table 3.8 indicate that of the 39 compartments with a RLF greater than or equal to 0.10 and a MAL of 1-3, 21 of them are compartments containing fiberglass toilet/shower units. Therefore, it can be expected that these units will be involved in a relatively high percentage of actual fires. These

Table 3.8 Involvement of Fiberglass Toilet/Shower Units in Fires

		Run No.	5-54	5-55	5-56	5-57
		Scenario	1	4	7	10
		Configuration	XRAY	XRAY	XRAY	XRAY
		Location	In Port	In Port	In Port	In Port
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	**Compartment Name**	**CUI**	**RLF**	**RLF**	**RLF**	**RLF**
1-34-2-Q	FAN ROOM	QF	0.22	0.47	0.55	1.34
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.35	0.56	0.83
01-54-6-L	T/S	LW	0.20	0.68	0.65	2.14
02-41-2-L	T/S	LW	0.20	0.48	0.46	1.06
1-44-2-Q	SCULLERY	QG	0.19	0.37	0.43	0.81
02-42-1-Q	FAN RM	QF	0.18	0.40	0.38	0.80
1-48-2-L	T/S	LW	0.17	0.37	0.45	0.95
1-40-4-T	UPTAKE	TU	0.17	0.26	0.35	0.51
02-33-2-L	T/S	LW	0.16	0.55	0.39	1.55
01-41-2-L	T/S	LW	0.15	0.36	0.39	0.86
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.26	0.34	0.61
02-36-1-L	T/S	LW	0.13	0.43	0.34	1.15
1-40-1-T	UPTAKE	TU	0.13	0.21	0.32	0.48
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.21	0.29	0.49
1-52-1-L	CREWS MESSROOM	LL	0.13	0.38	0.43	1.22
02-33-1-L	T/S	LW	0.13	0.47	0.38	1.44
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.13	0.36	0.40
1-42-1-Q	GALLEY	QG	0.10	0.17	0.64	1.17
01-26-2-L	T/S	LW	0.10	0.41	0.30	1.24
01-27-1-L	T/S	LW	0.10	0.40	0.30	1.24
01-14-2-L	T/S	LW	0.10	0.41	0.31	1.33
01-46-1-L	T/S	LW		0.42	0.29	1.58
03-15-0-C	PILOT HOUSE	C		0.28	0.20	1.12
01-34-1-L	T/S	LW		0.24	0.24	0.64
02-27-2-L	T/S	LW		0.23	0.13	0.89
01-6-0-Q	EMER SWBD & GEN RM	QE		0.19	0.34	0.86
02-14-1-L	T/S	LW		0.18	0.13	0.61
1-32-1-L	T/S	LW		0.18	0.12	0.35
1-28-4-L	T/S	LW		0.14	0.14	0.38
02-18-2-L	T/S	LW		0.14	0.08	0.40
01-54-1-C	COMMUNICATION CTR	C		0.13	0.04	1.19
01-17-1-L	T/S	LW		0.12	0.06	0.43
1-57-2-L	T/S	LW		0.12	0.11	0.28
2-29-1-Q	SEWAGE MCHRY RM	QA		0.11	0.16	0.21
1-57-2-L	T/S	LW		0.12	0.11	0.28
3-52-01-E	PROPULSION MTR RM	EE			0.13	0.33
1A-34-2-Q	MAIN DECK UTILITY SPACE NO. 4	QF				0.23
01-2-1-A	STRM NO 1	AS				0.17
1-66-2-L	T/S	LW				0.14

units are typically on the Main Deck, 01 Deck and O2 Deck where the joiner bulkheads do not extend to the underside of the deck above. Therefore any smoke produced will very likely spread to other compartments via the large utility void spaces. Since smoke produced is not only dense but extremely toxic, there is a very serious concern for life safety with these toilet/shower units installed throughout the ship.

3.2.7.3. In-Storage Scenario at the YARD

The VINDICATOR and PERSISTENT are presently planned for long term storage in a decommissioned, unmanned status at the Coast Guard YARD. The following prevailing conditions noted during the ship visit which will be in effect during this period are quite different from normal in port conditions:

- All access doors to the vessel on the Main Deck, 01 Deck, 02 Deck and 03 Decks are locked from the inside. Normal access to the ship is via an externally locked door to the Pilot House. All staterooms and many other compartments are locked. The distribution of the keys to these ships is unknown, but it is suspected that the distribution is severely limited to prevent vandalism and theft.
- Most of the fire hoses and portable fire extinguishers have been removed throughout the ship. Other fire protection equipment normally found in the repair locker such as OBAs, damage control kits, red devil blowers, etc. have also been removed. Therefore, in the event of a fire, virtually all firefighting equipment and personnel protective equipment would have to be transported to the ship from an external source. This would undoubtedly delay a rapid response to a fire.
- Additional smoke detectors have been temporarily installed in the Main Deck, 01 Deck and 02 Deck passageways. These detectors have been wired to the existing fire detection panel box in the Pilot House. The electrical cables for these additional smoke detectors have been routed through internal stairways and their access doors at each deck level. To prevent pinching the wires, these doors have been tied permanently open.
- The day the ship check was conducted, one roving watchstander entered the ship once during the eight hour work day for a brief security round. Therefore, it appears that the ship may be visited once a day for a very brief period.
- The probability of ignition that would ultimately lead to an unwanted fire is reduced compared to the normal in-port scenario because the normal duty section is not on board, there is no cooking in the galley, there is no machinery operating, there is very little electricity being consumed, and there is no hot-work being accomplished by the crew or YARD. However, lighting circuits are energized which generally involve fluorescent fixtures, and preheaters in the ductwork have already proven capable as an ignition source.

The contribution provided by automated systems and manual firefighting is essentially eliminated in this scenario due to the lack of personnel. In SAFE this is modeled by turning A and M "off" and considering that only passive fire protection is in effect. I values were left unchanged. To model the reduced probability of ignition, the frequency of EB was multiplied by .5 except for compartments in the EM and QE categories. Compartments in the EM and QE categories typically contain diesel engines which are responsible for starting the majority of serious fires on ships. Since the engines will not be operated while the ship is in-storage, the frequency of EB was reduced by a factor of .1 to realistically model the reduction in the probability of ignition. The results of running the probabilistic model on this "in storage" scenario are shown in Table 3.9 compared to the baseline in port scenario. The RLFs are considerably lower (safer ship) than in comparable in port scenarios. These results graphically demonstrate the very significant effect the frequency of EB has on the outcome. These results are considered realistic since the actual fire on the PERSISTENT has already demonstrated the fact that passive fire protection can be effective. Moreover historical records verify that fires involving multiple compartments on Medium Endurance Cutters are relatively rare. Despite these results, it would be prudent for the YARD to take note of the prevailing conditions noted above and plan for appropriate action in the event another fire occurs on a T-AGOS class vessel.

Table 3.9 Fire Safety of VINDICATOR While In Storage at the YARD

		Run No.	3-31	6-64
		Scenario	10	10
		Configuration	XRAY	XRAY
		Location	In Port	In Storage
		Fire Prot Level	I	I
Plan ID	**Compartment Name**	**CUI**	**RLF**	**RLF**
1-34-2-Q	FAN ROOM	QF	1.15	.20
3-34-0-E	MAIN GENERATOR RM	EM	0.83	.16
1-44-2-Q	SCULLERY	QG	0.79	.20
02-42-1-Q	FAN RM	QF	0.74	.25
1-40-4-T	UPTAKE	TU	0.51	.09
2-52-0-C	MAIN CONTROL STATION	C	0.61	.11
1-40-1-T	UPTAKE	TU	0.48	.09
2-24-4-Q	A/C MCHRY SPACE	QA	0.49	.11
1-52-1-L	CREWS MESSROOM	LL	1.10	.30
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.40	.04
1-42-1-Q	GALLEY	QG	1.13	.30
01-6-0-Q	EMER SWBD & GEN RM	QE	0.80	.27
2-29-1-Q	SEWAGE MCHRY RM	QA	0.21	.00
03-15-0-C	PILOT HOUSE	C	1.05	.23
3-52-01-E	PROPULSION MTR RM	EE	0.29	.06
01-54-1-C	COMMUNICATION CTR	C	0.98	.17
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.22	.00
01-2-1-A	STRM NO 1	AS	0.16	.01

3.2.7.4. Flammable Liquid Line Rupture Scenario

Historically, fires in Engine Rooms have frequently led to large dollar losses. Class B spray fires are often responsible for these losses due to the fact they can lead to full room involvement conditions in a very short time and before the crew can respond to extinguish the fire. SAFE has the capability to model a typical flammable liquid line rupture (FLLR). The model requires the user to specify the number of gallons of fuel that will be added to the compartment's fuel load due to the rupture, the room of origin, and its associated FRI time. This scenario was modeled for the VINDICATOR specifying the Main Generator Room as the room of origin and a FRI time of two minutes. The leakage rate was assumed to be 20 gallons per minute for two minutes or 40 gallons. It is anticipated that the crew would be able to secure the fuel leak within this period and assumes that remote fuel cutoffs will be installed as part of the conversion project. The results of running the probabilistic model with this scenario is shown in Table 3.10 compared to the baseline. The results show that many compartments have higher RLFs (less safe) in a FLLR scenario compared to the baseline, all compartments still exceed FSOs by a substantial margin. These results are attributed to the effectiveness and efficiency of the installed Halon 1301 total flooding system.

Table 3.10 Results of the Flammable Liquid Line Rupture Scenario

		Run No.	3-28	3-58
		Scenario	1	1
		Configuration	XRAY	XRAY
		In Port	In Port	In Port
		Fire Prot Level	I,A,M	I,A,M
Plan ID	Compartment Name	CUI	RLF	RLF
1-34-2-Q	FAN ROOM	QF	0.22	0.28
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.28
1-44-2-Q	SCULLERY	QG	0.19	0.23
02-42-1-Q	FAN RM	QF	0.18	0.22
1-40-4-T	UPTAKE	TU	0.17	0.20
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.18
1-40-1-T	UPTAKE	TU	0.13	0.17
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.16
1-52-1-L	CREWS MESSROOM	LL	0.13	0.16
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.12
1-42-1-Q	GALLEY	QG	0.10	0.13
2-29-1-Q	SEWAGE MCHRY RM	QA		0.10

3.2.8. CONDUCT COST-BENEFIT ANALYSIS

The goal of the fire safety analysis is to maximize the benefit (improvement in fire safety), while minimizing the costs (dollars and other intangible factors) of the changes. A cost-benefit analysis is thus considered a vital part of the fire safety analysis. Within the constraints of time and allowable funds, as many alternatives as possible are studied to permit a useful cost-benefit analysis. Since all compartments in the VINDICATOR exceed FSOs by a substantial margin, no improvements are required to bring the ship up to minimally acceptable standards. Accordingly, a cost-benefit analysis of alternatives is not applicable for the VINDICATOR.

3.2.9. DOCUMENT RESULTS

This report contains comprehensive results and provides the basis of assumptions and estimates when complete or factual information was not available. The appendices summarize the data and detailed results. Additional insight can be gained by referring to the other technical reports and documents referenced throughout this report.

4. FIRE PROTECTION DOCTRINE

4.1. BACKGROUND

4.1.1. MAIN SPACE FIREFIGHTING DOCTRINE

The Main Space Firefighting Doctrine, published as Commandant Instruction M9555.1, applies to class B fires in the machinery spaces on all Coast Guard cutters 65' and greater in length [21]. The purpose of this doctrine is to delineate the tactics, philosophy, and procedures associated with the use and operation of the various firefighting systems and equipment on board the cutter for combating machinery space fires. The doctrine is structured to provide a basis for the proper actions and decisions of the firefighting crew and the considerations necessary in choosing the correct firefighting equipment and agent. The doctrine also defines personnel responsibilities and scenarios such as a major oil leak which could result in a class B fire.

The main space firefighting doctrine for Coast Guard cutters was written in a general manner to apply to all floating units. It was designed primarily for the larger cutters; all cutters were supposed to tailor the doctrine to suit their individual needs. The doctrine is difficult to tailor because crew sizes, state of training and installed firefighting equipment vary considerably in the Coast Guard fleet. Finally, the format of the doctrine was organized such that general information pertaining to fire science, guidance from the Commandant and other authorities, and specific tactical procedures for a particular cutter were mixed throughout the document. Consequently, an objective of the SCFP project was to provide a firefighting doctrine designed primarily for the needs of the small cutter. This objective was achieved by expanding the scope of the doctrine to include procedures for all classes of fire in all types of compartments and reformatting the doctrine into three parts. The following sections of this report describe the new fire protection doctrine.

4.1.2. FIRE PROTECTION DOCTRINE

Prior to this report, ten classes of small Coast Guard cutters have been analyzed in the SCFP project. A fire protection doctrine has been developed which is tailored to each class of cutter; only minor changes are required for each cutter in the class to account for uncompleted SHIPALTS, changes in compartmentation due to different subclasses, etc. The format of the new doctrine is significantly different than the format of the Main Space Firefighting Doctrine. The following sections describe the format and scope of the new fire protection doctrine as well as procedures for maintaining this document.

4.1.2.1. Fire Protection Doctrine Format

The new fire protection doctrine is organized into three parts. Part A includes information and facts concerning fire science and firefighting such as the effectiveness of various firefighting agents on the different classes of fires. This part applies equally to all cutters (large and small) and rarely changes over time. The development of a new firefighting agent would be an occasion worthy of updating Part A. Note this revision would not require the use of that agent on any particular ship.

Part B incorporates guidance promulgated by the Commandant, U. S. Coast Guard. The format of this new doctrine calls for two different versions of Part B - one applicable to small cutters (less than 180' in length) and the other applicable to large cutters (180' and greater in length). This distinction is based on several factors including crew size, type of hazard due to main propulsion equipment, quantity and timeliness of support likely to be available, and area of operations. At the Commandant's discretion, portions of Part B may be similar for both large and small cutters. Circumstances for activating a gas turbine enclosure local fire extinguishing system is an example of guidance the Commandant would provide in Part B for large cutters only since gas turbines are not used on small cutters. On the other hand, since crews of small cutters are generally able to safely abandon ship due to their proximity to shore, the Commandant may provide guidance of when that would be appropriate for small cutters only.

Part C contains the tactical procedures to combat all classes of fires, in all types of compartments, in port and at sea. This part is developed for a representative cutter for each class. Other cutters in the class will have to tailor this part to account for uncompleted (or unauthorized) SHIPALTS and other differences that would require different tactics. **The Commanding Officer of the cutter has the responsibility to ensure this tailoring is accomplished in a timely manner and that such changes do not contradict the guidance provided in Parts A and B**.

4.1.2.2. Scope

This report provides a tailored fire protection doctrine, documented in Appendix D of this report, for the VINDICATOR as configured for use by the Coast Guard as a Medium Endurance Cutter (WMEC) with a crew of 35 Coast Guard personnel. Part A of the fire protection doctrine, included in Appendix D to this report was previously developed as part of the SCFP. Parts B and C of the fire protection doctrine were specifically developed as part of the VINDICATOR fire safety analysis project.

The fire protection doctrines developed for the nine classes of small cutters previously studied in the SCFP included firefighting procedures for every accessible compartment. This approach is impractical for the much larger VINDICATOR due to the fact there are 170 accessible compartments in the cutter. The individual compartments selected for development of firefighting procedures were therefore limited to those which met one or more of the following criteria:

- Firefighting procedures for each class of fire and typical combination of classes are desired in the doctrine
- Access or egress routes may not be immediately obvious
- Unusual firefighting tactics may be necessary to deal with conditions that exist in the compartment
- The compartment has a relatively high historic frequency of EB
- The fuel loads or fuel load densities are considered relatively high compared to other compartments

- Compartments designated as engineering spaces
- Compartments with automated fire protection systems installed
- Compartments which have relatively high RLFs in the Baseline Fire Safety Analysis
- Compartments which are considered critical to the ship's primary missions

4.1.2.3. Future Revisions

Part A of the doctrine presents the principles of fire science that pertain to shipboard firefighting and other factual information to enable a crew member to make the proper selection of firefighting equipment and agents to combat a particular class of fire. Revisions to this part should rarely be required. The introduction of a new firefighting agent or equipment by industry is the most likely scenario that would require updating Part A. This revision is only required if the new agent or equipment is used somewhere in the Coast Guard fleet.

Part B represents guidance from the Commandant and other Naval authorities applicable to either large cutters or small cutters. Recent conflagrations on the USS STARK and USS ROBERTS provided many lessons learned; these fires are examples of scenarios that would likely result in new or additional guidance provided to the fleet.

Changes to Part C will usually be required in the event of SHIPALTS that affect the firefighting capabilities or compartmentation of the Cutter. In addition, new Commanding Officers are likely to change Part C (within the constraints of Parts A and B) due to their own beliefs, experiences, and desires.

It is expected that the Commandant, U.S. Coast Guard will issue revisions to Parts A and B as necessary, while Commanding Officers will be responsible for revising Part C for their own cutter. The revision page of the doctrine should document the authority who issued the change.

4.2. FIRE PROTECTION DOCTRINE FOR USCGC VINDICATOR (WMEC 3)

As noted above, Part C of the doctrine contains ship specific information relative to firefighting procedures on the VINDICATOR, configured for use as a Medium Endurance Cutter. Since the conversion of the VINDICATOR from a T-AGOS class ship to a WMEC is incomplete, certain information required to complete portions of Part C is not known with certainty. Moreover, the assumption is made that the ship will be in compliance with all Coast Guard requirements for a WMEC following conversion. A thorough ship-check will be needed after the conversion is completed to add the missing information where indicated in the doctrine (by the term "TBD") and validate the various assumptions documented in Appendix B and elsewhere in this report concerning compliance with the Naval Engineering Manual. Consequently, the doctrine included in this report as Appendix D is necessarily incomplete, however, the effort required to complete it is considered minimal.

As noted above, due to the large number of compartments on this cutter, there was a need to reduce the number of individual scenarios to a reasonable number that would be described in Part C. Compartments to be included in Part C were identified by applying the criteria discussed in section 4.1.2.2 and shown in Table 4.1. The compartments shown as rows in this table were the compartments that fit one or more of the criteria shown as columns. The number of individual scenarios was thus reduced to 22 even though there are 170 accessible compartments in this cutter.

Table 4.1 Compartments for Inclusion in Part C of the Fire Protection Doctrine

Plan ID	Compartment Name	FF Procedures for Each Class of Fire	Access or Egress Problems	Unusual FF Tactics Required	High Frequency of EB	High Fuel Loads or Fuel Load Density	Engineering Spaces	Automated Fire Protection Systems	Relatively High RLF's in Baseline	Mission Critical Compartments
03-15-0-C	Pilot House	A/C								¤
02A-14-0-Q	Upper Dk Util Space No. 1	A	¤	¤						
1-54-2-L	Crews SR (3)	A				¤				
02-27-2-L	T/S	A				¤				
1-34-2-Q	Fan Room	A/C				¤			¤	
01-6-0-Q	Emer Swbd & Gen Rm	A/B/C			¤		¤	¤	¤	
01-G-0-A	Bosun Stores	A				¤				
01-69-1-Q	Hyd. Power Rm	B			¤	¤	¤	¤		¤
01-68-0-Q	Electronic & Elect. Shop	A/C						¤		
1-D-0-A	Steward Storeroom	A				¤				
01-54-1-C	Communication Center	C							¤	¤
2-52-0-C	Main Control Station	A/C							¤	¤
3-52-01-E	Propulsion Mtr Rm	C			¤		¤	¤	¤	¤
3-34-0-E	Main Generator Rm	B/C			¤		¤	¤	¤	¤
2-6-0-E	Bow Thruster Elec Mtr Rm	B/C					¤	¤	¤	¤
2-24-4-Q	A/C Mchry Space	A/C			¤		¤		¤	
2-94-0-Q	Steering Gear Rm	B			¤		¤			¤
1-42-1-Q	Galley	A/B/C			¤			¤	¤	¤
1-44-2-Q	Scullery	A							¤	¤
1-40-1-T	Uptake	A/B					¤		¤	¤
2-24-1A-Q	Laundry Rm	A/B/C			¤	¤				
2-86-1-L	Tunnel	B				¤				

5. CONCLUSIONS AND RECOMMENDATIONS

This report describes the results of the fire safety analysis of the U.S. Coast Guard Cutter VINDICATOR (WMEC 3). The VINDICATOR is one of 18 ships in the Auxiliary General Ocean Surveillance (T-AGOS) class and was previously operated under contract let by the Military Sealift Command, U.S. Navy. The VINDICATOR is the first T-AGOS class ship to be converted for use by the U.S. Coast Guard as a Medium Endurance Cutter (WMEC). An interim report discussing the results of the preliminary baseline fire safety analysis was submitted but is not generally available in the literature, however it may be available upon request from the Marine Fire and Safety Research Branch, U. S. Coast Guard Research and Development Center [19]. Since this is the final report in the project, the conclusions and recommendations presented herein include some of those documented in the interim report. The two major objectives established for this project include the performance of a detailed fire safety analysis and development of a comprehensive fire protection doctrine for the VINDICATOR configured as a WMEC. This section of the report is organized in a manner that corresponds to these objectives.

5.1. FIRE SAFETY ANALYSIS

The most important objective in this project is to analyze the fire safety of the VINDICATOR configured as a WMEC. As the eleventh cutter to be analyzed using the Ship Fire Safety Engineering Methodology (SFSEM) in the past five years, fire safety analysis results for the VINDICATOR may be compared to the results of the ten previously analyzed cutters in the Small Cutter Fire Protection Project [3, 4]. Results of the baseline fire safety analysis of the VINDICATOR are consistent with the results from previous work in the SCFP and in agreement with historical records for medium endurance cutters in the Coast Guard. Baseline results in the SCFP indicate that fire protection levels in most compartments, with passive, automated and active fire protection features in effect, generally meet Fire Safety Objectives (FSO).

A preliminary fire safety analysis of the VINDICATOR was conducted in conjunction with a review of the conversion specifications and drawings as well as a visit to the Coast Guard YARD where the vessel is being converted. The results of the baseline fire safety analysis using the SFSEM/SAFE precluded the need to study alternatives to improve fire safety in compartments which failed to meet FSOs. Instead, four specific scenarios/design features were studied to determine their relative effect on the fire safety of the converted cutter. The following sections describe the conclusions and recommendations of the preliminary and baseline fire safety analyses as well as the analyses of the four scenarios/design features that were studied.

5.1.1. PRELIMINARY FIRE SAFETY ANALYSIS

The preliminary analysis was limited in scope since the ship has not been fully converted and there was limited documentation available. In addition, the crew was not available to conduct a fire drill or participate in discussions. However, a thorough review of the conversion specifications, available drawings, and discussions with the Coast Guard YARD led to the following observations:

- Marine plywood is used extensively as joiner bulkheads on the Main Deck and above. These bulkheads are not carried to the underside of the deck above thus creating large utility void spaces which may contribute to the spread of smoke and flame.

- There is no dedicated paint locker, consequently paint and other flammable liquids are stowed in fan rooms and other inappropriate locations throughout the ship.
- Staterooms and berthing areas are presently outfitted with nylon carpets, overstuffed chairs, and refrigerators which represent significant fuel loads and ignition hazards.
- The present fire detection system serves primarily engineering spaces and is not designed to monitor staterooms and passageways as required by the Naval Engineering Manual [5].
- The existing compartmentation and accesses are not numbered or classified for damage control purposes in accordance with current regulations in the Naval Ships Technical Manuals [1]. In addition remote diesel engine shutdowns and compartment check-off lists are non-existent.
- Access for firefighting purposes and egress routes for crew members are presently blocked by locked doors. Moreover, numerous automatic door closers are defeated by tieing open the door.
- Most of the damage control equipment including portable fire extinguishers and fire hoses have been removed from the ship.

It is recommended that the scope of the conversion project include a requirement to bring the ship into total compliance with all applicable regulations for firefighting and damage control specified in, but not limited to, the Naval Engineering Manual and the Naval Ships Technical Manuals.

5.1.2. BASELINE FIRE SAFETY ANALYSIS

Based on a comprehensive fire safety analysis, all compartments in the VINDICATOR meet FSOs by a substantial margin with passive, automated, and manual fire protection features in effect. These results are shown graphically in Figure 5.1. Without considering the contribution provided by manual firefighting efforts, the VINDICATOR meets FSOs in every compartment (just passive and automated fire protection in effect) as shown in Figure 5.2. Similarly, without considering the contribution provided by automated fire suppression, the VINDICATOR meets FSOs in every compartment (just passive and manual fire protection in effect) as shown in Figure 5.3. As shown in Figure 5.4, four compartments fail to meet FSOs with just passive fire protection in effect, and several others are close to failing FSOs. **Therefore passive fire protection has to be augmented by automated fire suppression or manual firefighting efforts for the VINDICATOR to meet FSOs in all compartments.**

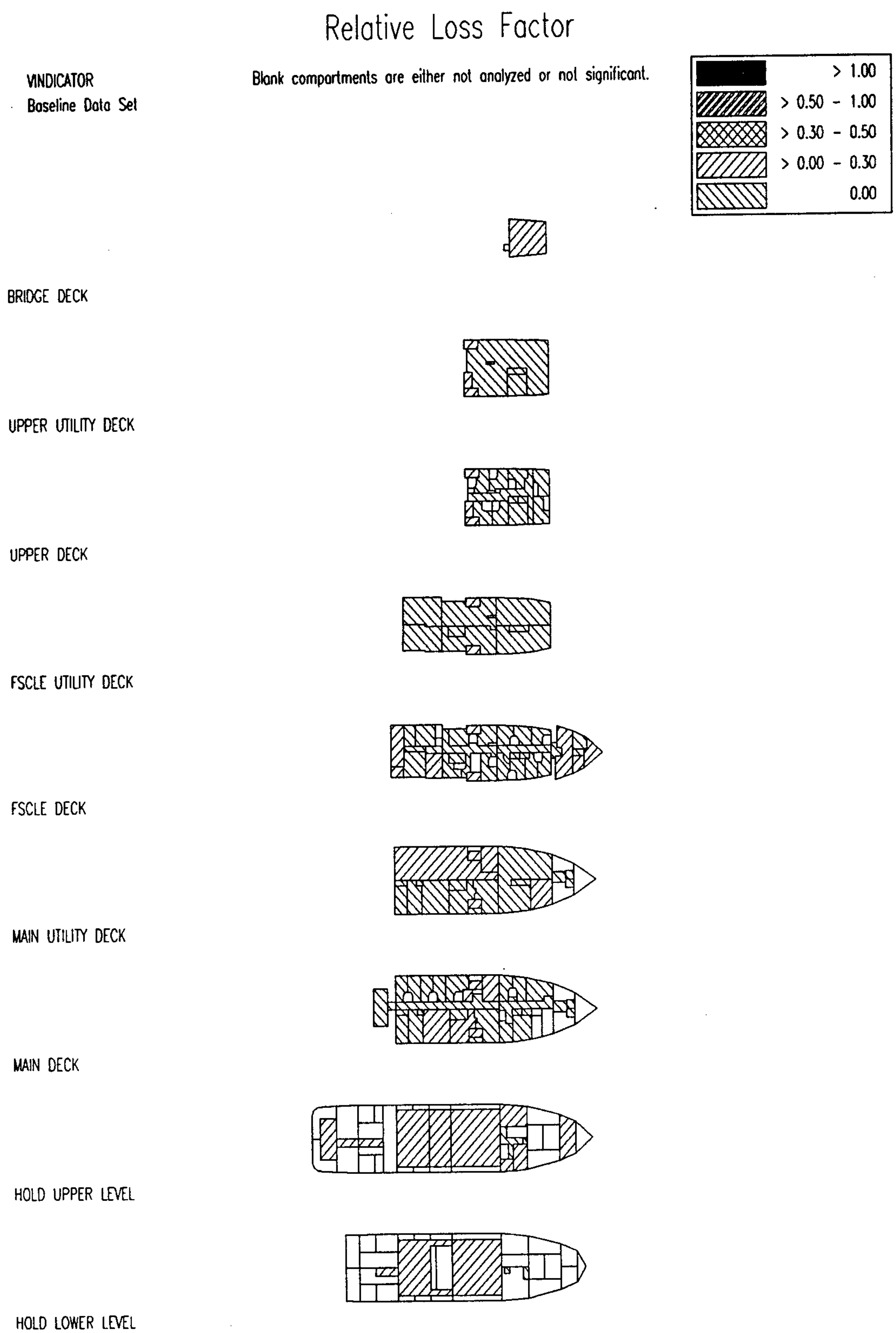

Figure 5.1 Relative Loss Factors, Baseline Scenario 1

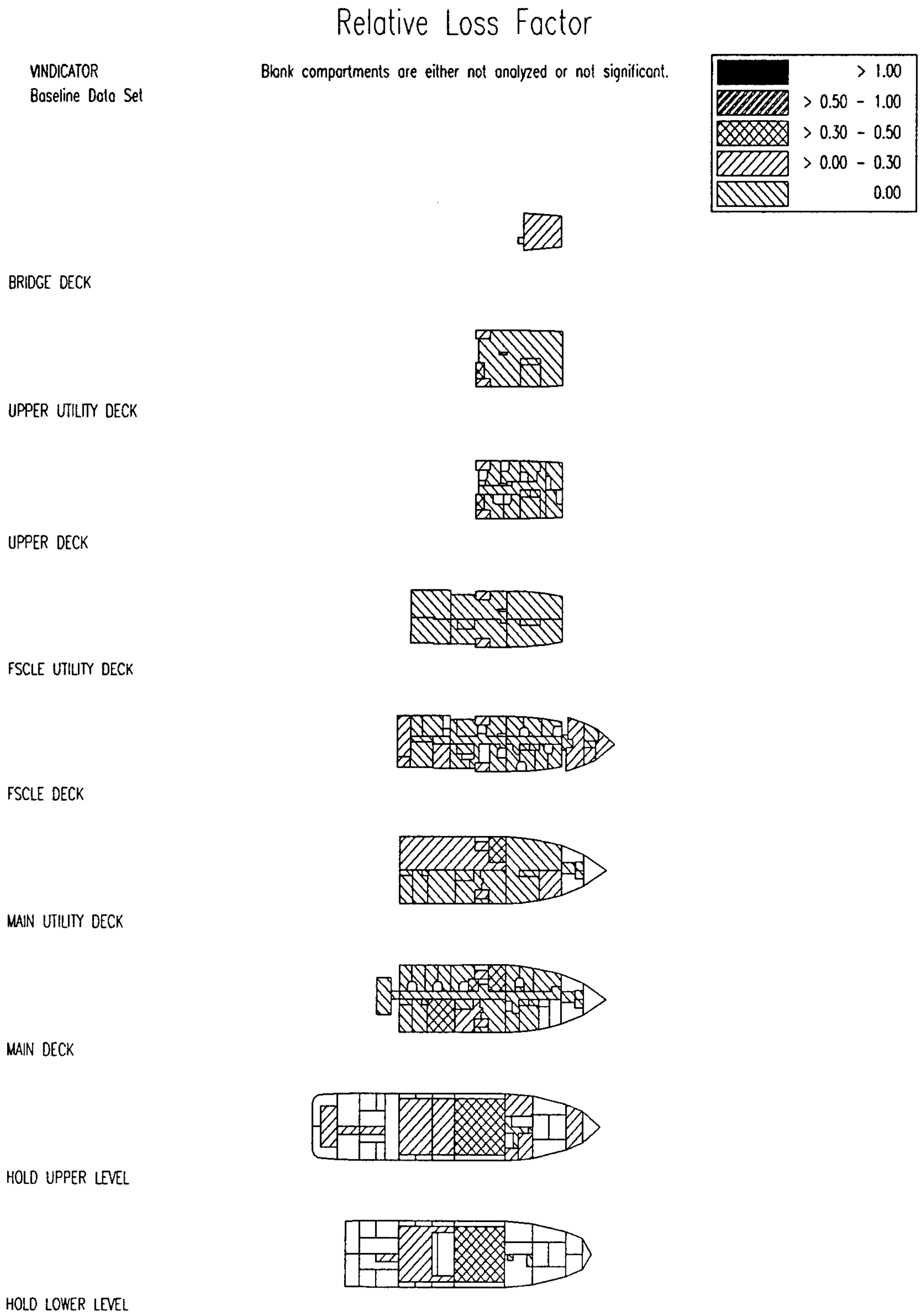

Figure 5.2 Relative Loss Factors, Baseline Scenario 4

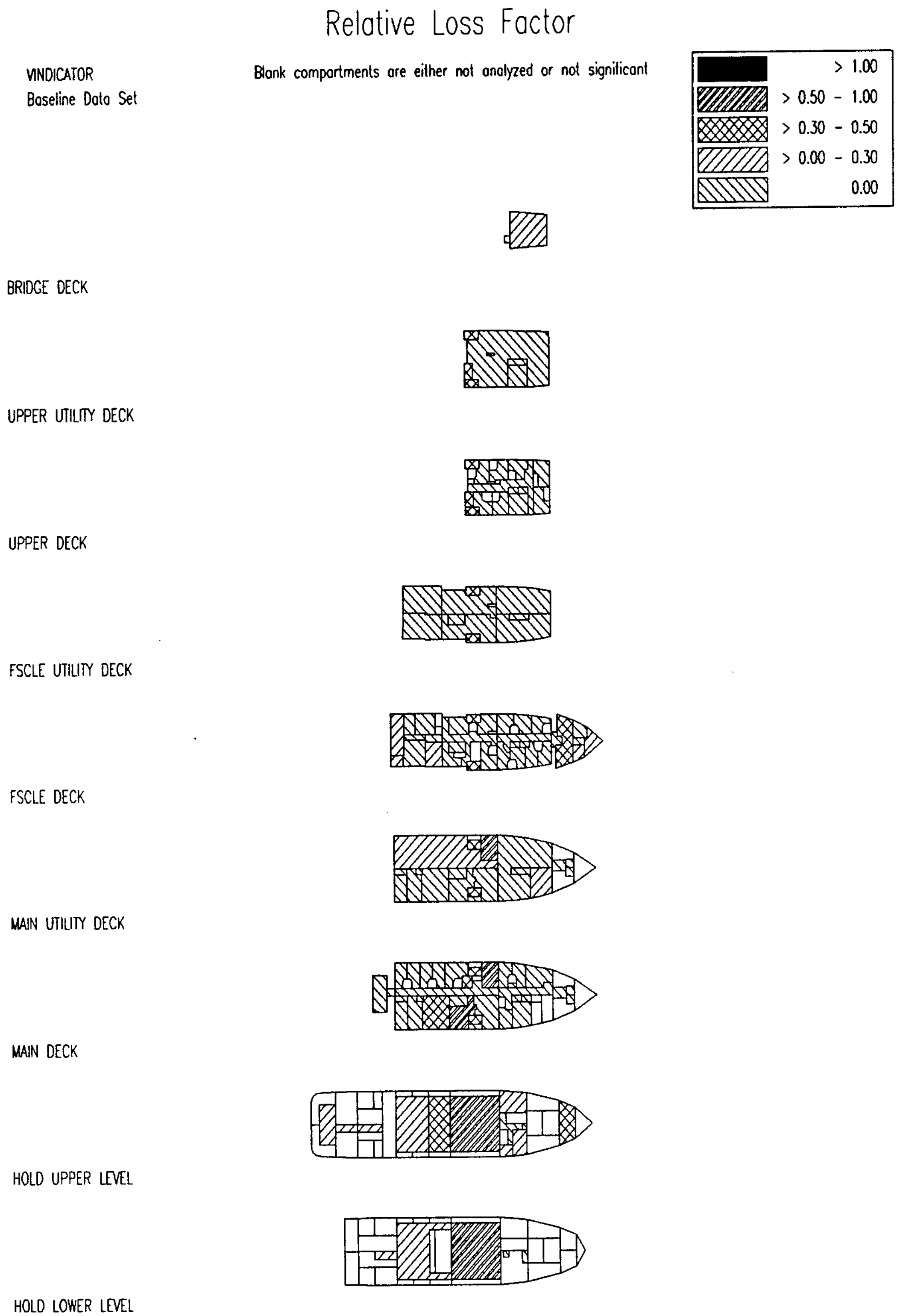

Figure 5.3 Relative Loss Factors, Baseline Scenario 7

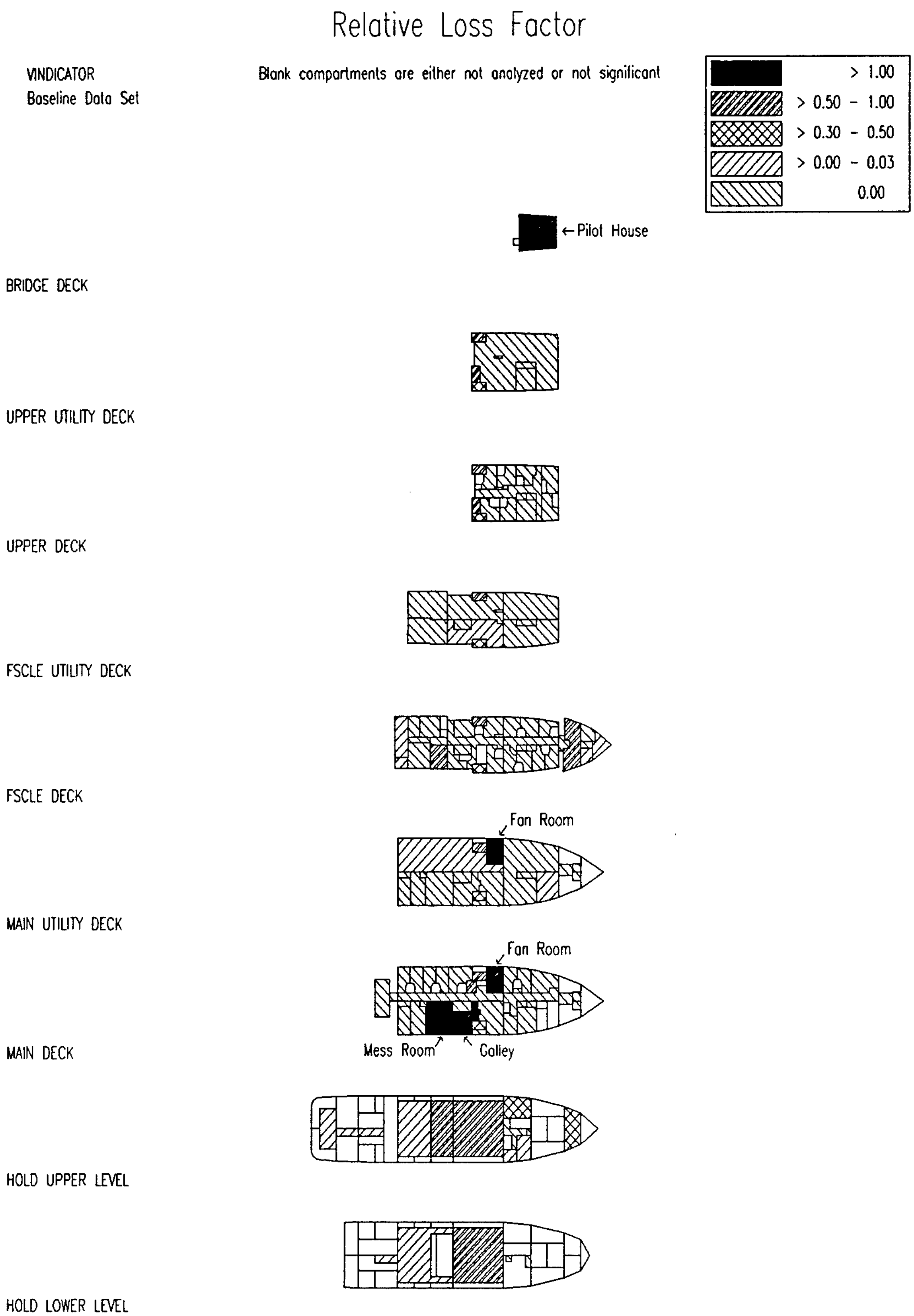

Figure 5.4 Relative Loss Factors, Baseline Scenario 10

Based on historical records, the other classes of U.S. Coast Guard Medium Endurance Cutters had a frequency of reportable fires equal to 1 reportable fire every 10.3 years based on 134 cutter years of data (34 ships over 4 years). Therefore, relatively high fire safety levels are expected in this type of cutter. Based on a thorough baseline fire safety analysis, the very high fire safety levels in the VINDICATOR are attributed to the following:

- The ship is equipped with automated fire suppression systems in engineering spaces spaces with historically high frequencies of Established Burning (EB). The Main Generator Room is equipped with two automated fire suppression systems.
- The integrity of the bulkheads and decks which provide passive fire protection as barriers to the spread of fire are not degraded due to deterioration or poor maintenance. An actual fire on the PERSISTENT demonstrated the effectiveness of passive fire protection on this class vessel.
- Fuel loads and fuel load densities as planned for the converted cutter, shown in Figures 5.5 and 5.6, are considered comparable to other cutters and not unusually high. Moreover, the Frequency of EB shown for each compartment in Figure 5.7, indicates that compartments with a relatively high frequency of EB do not have relatively high fuel load densities.
- The VINDICATOR is equipped with an automatic fire detection system that monitors the engineering spaces and other spaces with historically high frequencies of EB, thus early warning of fires and timely setting of Condition ZEBRA is assured in port and at sea.
- It is presumed that adequate quantities of firefighting equipment will be installed throughout the cutter that provide ready access to the appropriate firefighting agent for the anticipated fire threat.
- The compartmentation shown in the preliminary design permits safe and easy access to all spaces for firefighting purposes. It is presumed that the current locks will be removed on the converted cutter.

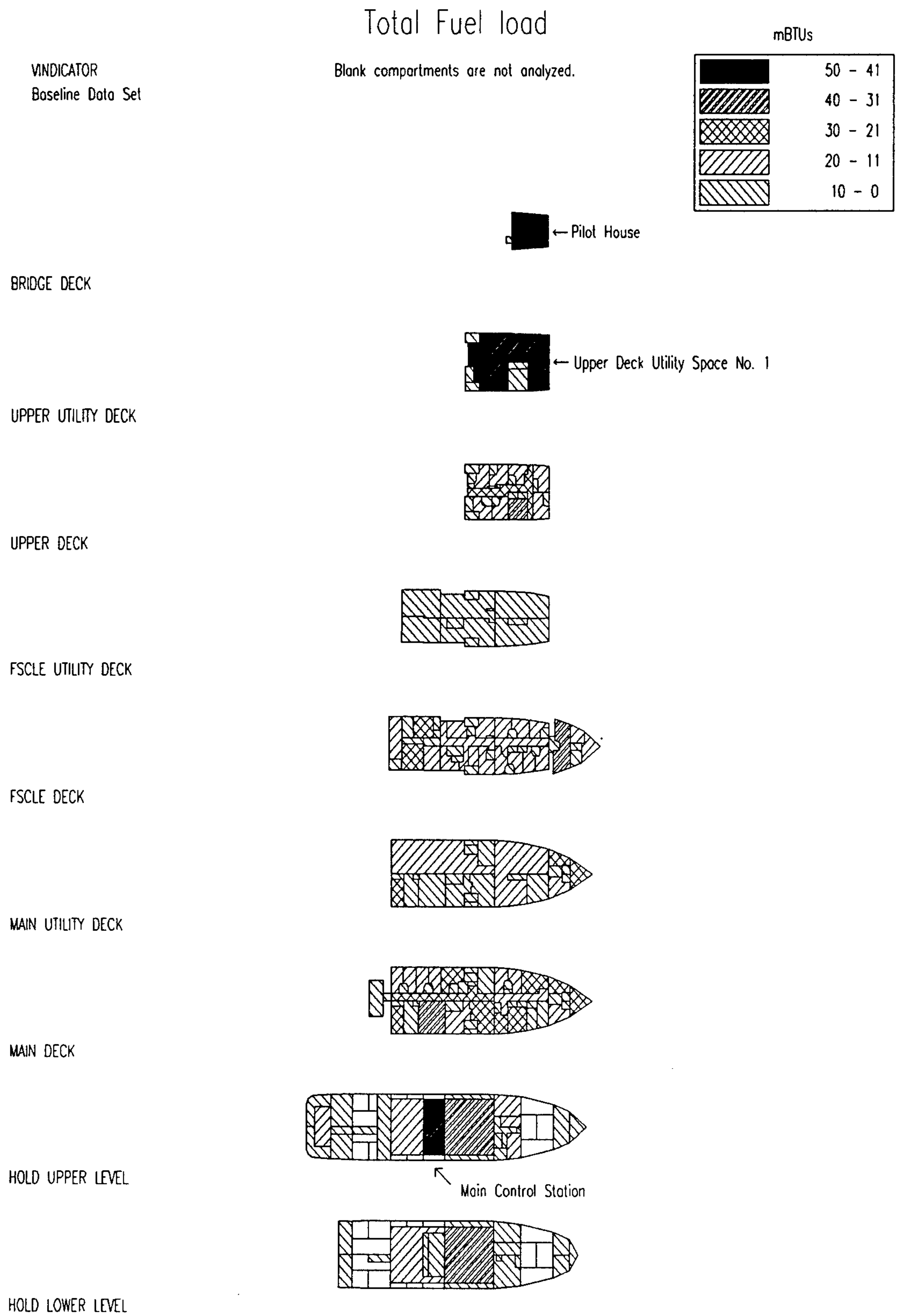

Figure 5.5 Estimated Fuel Loads in the VINDICATOR

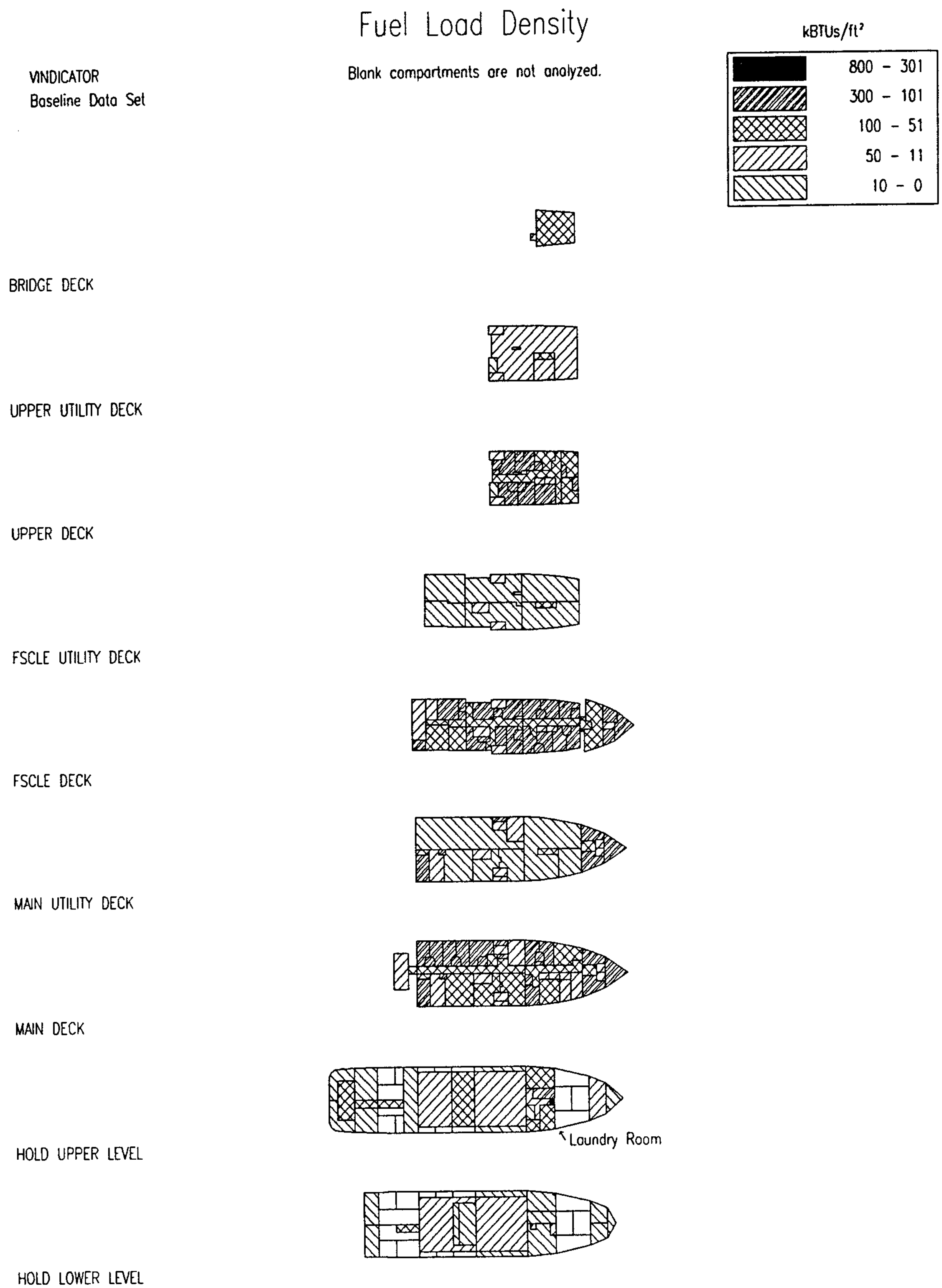

Figure 5.6 Estimated Fuel Load Densities on the VINDICATOR

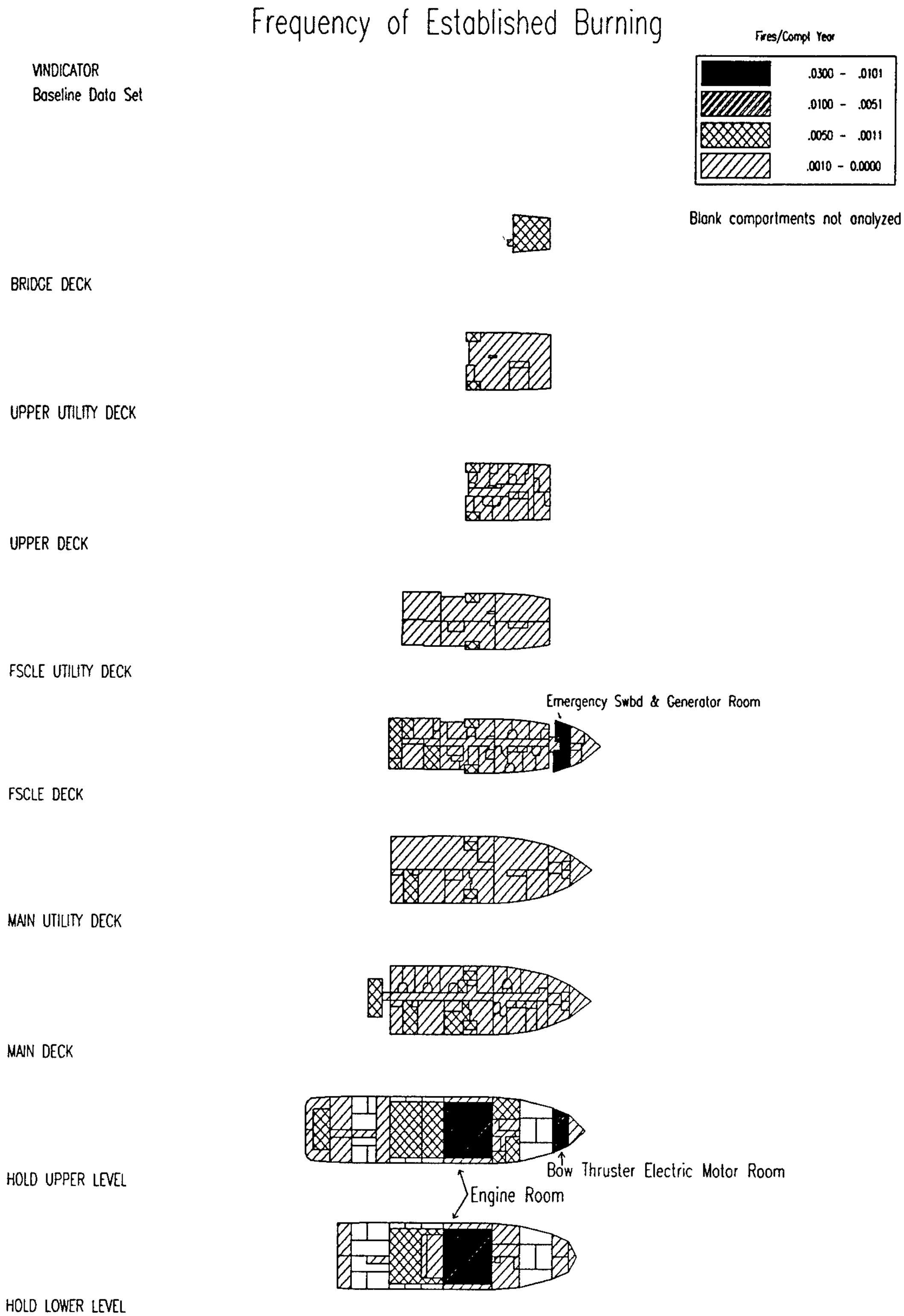

Figure 5.7 Frequency of EB in the VINDICATOR

5.1.3. ANALYSIS OF ALTERNATIVES

Four alternatives were analyzed to gain insight into the relative effect of various fire protection features and scenarios on the relatively high baseline fire safety levels of the VINDICATOR. The significant conclusions and associated recommendations from this study are discussed in detail in section 3.2.7. and summarized in the following list:

- Since the baseline fire safety analysis shows that all compartments meet FSOs by a substantial margin, it may be concluded that the ship is over-protected. There are six independent Halon 1301 total flooding systems which may be considered for removal due to their adverse effect on the environment. If these systems were to be removed there would be a need to increase the reliance on the crew for manual firefighting to supplant the loss of the fire protection presently provided by automated systems. **Therefore it is recommended that the existing Halon 1301 systems be retained as called for in the present conversion plans.**

- One-piece fiberglass toilet/shower units are installed on the Main Deck, 01 Deck, and 02 Deck. Fiberglass is known to produce copious quantities of dense black smoke and toxic gases. Joiner bulkheads on these decks are not carried to the underside of the deck above thus creating large void spaces above the celotex dropped ceilings. The lengthy longitudinal passageways on these three decks are not equipped with smoke curtains or joiner doors. Therefore, the smoke and toxic gases from the burning fiberglass will be easily and quickly transported throughout the affected deck. **The combination of fiberglass and inability to contain the smoke/toxic gases is considered an unacceptable threat to life safety.** Implementing one or more of the the following recommendations would mitigate or eliminate this risk: (1) Replace the existing fiberglass toilet/shower units with non-combustible construction materials. (2) Extend the existing joiner bulkheads on the Main Deck, 01 Deck and 02 Decks to the underside of the deck above. (3) Install smoke curtains or joiner doors in at least two strategic locations in both the Main Deck and 01 Deck Passageways, and in at least one location in the 02 Deck Passageway.

- As discussed in section 3.2.7.3. of this report, the prevailing conditions on the VINDICATOR and PERSISTENT during the period they will be in long term storage at the Coast Guard YARD are considered conducive to fire spread. Restricted access to the vessel may significantly delay a rapid response to a fire. Furthermore, the lack of damage control equipment on board including fire hoses and portable fire extinguishers requires that nearly 100% of the firefighting equipment will have to be transported to the scene of any fire from external sources at the YARD. An analysis of the in-storage scenario shows that the extraordinarily low probability of ignition mitigates the risk to a large degree. **It is recommended that the YARD develop a detailed plan for firefighting on these ships that includes details of personnel and firefighting equipment that will be used in response to a fire.** It is further recommended that this plan be tested by conducting monthly fire drills.

- A flammable liquid line rupture scenario was modeled using the SFSEM/SAFE. While the results showed a decrease in baseline fire safety levels, all compartments continue to exceed FSOs by a substantial margin with passive, automated and manual fire protection in effect.

5.2. FIRE PROTECTION DOCTRINE

The second objective in this project is the development of a tailored fire protection doctrine for the USCGC VINDICATOR (WMEC 3). The new doctrine, submitted in its entirety with this report as Appendix D, describes procedures and tactics for combating all classes of fire in all types of

compartments. The doctrine is in consonance with official Coast Guard policy published in the Naval Engineering Manual [5], and other official publications such as the Naval Ships' Technical Manuals [1, 6]. In addition, it incorporates approved recommendations and comments from Coast Guard Headquarters received in response to the interim technical reports previously submitted in the SCFP.

This doctrine reflects various assumptions made by the engineer/analysts when detailed information concerning the conversion of this T-AGOS class ship to a Medium Endurance Cutter was lacking. These assumptions are documented in Appendix B and elsewhere in this report. **Due to these assumptions and the dynamically changing nature of the conversion project, it is imperative that this doctrine be updated, based on a thorough ship-check, after the conversion project has been completed and prior to using this doctrine for training or indoctrination of the new crew.** Due to incomplete information, certain portions of Part C of the new fire protection doctrine are necessarily incomplete. For example the details concerning: location and operation of remote shutdowns for diesel engines; quantity, type, and location of portable fire extinguishers; and location and quantity of additional fire detectors that may be installed are unknown and need to be included in the new doctrine.

REFERENCES

1. Naval Ships' Technical Manual, NAVSEA 0901-LP-079-0010, Chapter 079, "Damage Control, Stability and Buoyancy," Author/Sponsor: Naval Sea Systems Command, 15 August 1976.

2. Sprague, Chester M., "Theoretical Basis of the Ship Fire Safety Engineering Methodology," Technical Note 058, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, February, 1992.

3. Sprague, Chester M., "Small Cutter Fire Protection Project", 2 Volumes, R&DC Report No. 13/94, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, November, 1994.

4. Sprague, Chester M.; Holmstedt, Herbert A.; Romberg, Betty; and Dolph, Brian, "Fire Safety Analysis of the 175' WLM (R) Coastal Buoy Tender," Report No. 35/94, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, December, 1994.

5. "Naval Engineering Manual," Commandant Instruction M9000.6B, Change 1, U.S. Department of Transportation, U.S. Coast Guard, May, 1994.

6. Naval Ships' Technical Manual, S9086-S3-STM-010, Chapter 555, "Shipboard Firefighting," First Revision, Author/Sponsor: Naval Sea Systems Command, 1 June 1993.

7. "Surface Ship Survivability Manual," Naval Warfare Publication 62-1 (Rev C), December, 1989.

8. Engineering Casualty Control Manuals, U.S. Department of Transportation, U.S. Coast Guard. (A separate Casualty Control Manual exists for each CG Cutter.)

9. "Vessel Safety Manual", North Pacific Fishing Vessel Owner's Association, Editor: John Sabella, 1986.

10. "Marine Fire Prevention, Firefighting and Fire Safety," Maritime Administration, U.S. Department of Commerce, Maritime Training Advisory Board, Published by the Robert J. Brady Co. for the National Maritime Research Center, 1979.

11. Clouthier, Elizabeth; Rich, Doris; and Romberg, Betty, "SAFE User Manual Version 2.2, A Computer Model for the Implementation of The Ship Fire Safety Engineering Methodology", Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, June 1995.

12. Peatross, Michelle J., Beyler, Craig L., Back, Gerard G., "Validation of Full Room Involvement Time Correlation Applicable to Steel Ship Compartments", Report CG-D-16-94, November, 1993.

13. Richards, Robert C., "Fire Safety Analysis of the Polar Icebreaker Replacement Design," 3 Volumes, Report No. CG-M-04-88, October, 1987.

14. Nash, Louis; Cummings, W. Mark; and Sprague, Chester M., "Fire Safety Analysis of the U.S. Coast Guard Cutter VIGOROUS FP 570 Fire Protection Analysis," MFRB Technical Note 1056, prepared for U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, December, 1990.

15. Sprague, Chester M., "Analysis of the Cutter Standard Repair Locker Inventory," Letter Report, Prepared for the U.S. Coast Guard Marine Safety Laboratories, December, 1990.

16. Sprague, Chester M., "Preliminary Fire Safety Analysis of Three Small Coast Guard Cutters," Interim Technical Report, Prepared for the U.S. Coast Guard Marine Safety Laboratories, June, 1991.

17. Sprague, Chester M., "Fire Safety Analysis of Three Small Coast Guard Cutter Classes," 4 Volumes, Interim Technical Report, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, July, 1992.

18. Holmstedt, Herbert A., "Fire Safety Analysis of Six Small Coast Guard Cutter Classes," 7 Volumes, Technical Report, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, September, 1993.

19. Holmstedt, Herbert A.., Romberg, Betty H., and Sprague, Chester M., "Preliminary Results, Baseline Fire Safety Analysis, CG Cutter VINDICATOR (WMEC 3)", CompuCon, Interim Report, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, November, 1994.

20. "Cutter Standard Repair Locker Inventory," Commandant Instruction M9664.1, U.S. Department of Transportation, U.S. Coast Guard, July 19 1989.

21. Machinery Space Firefighting Doctrine for Class Bravo Fires, Commandant Instruction M9555.1, U.S. Department of Transportation, U.S. Coast Guard, June 15, 1989.

Appendix A

COMPARTMENTATION

Figure A.1 serves as a legend to explain access fittings (doors, scuttles, and hatches) in Figures A-2 through A-6. Table A.1 is a tabulation of compartments in the U.S. Coast Guard Cutter VINDICATOR (WMEC 3).

The inboard and outboard profile views of the VINDICATOR are shown in Figure A.2. The plan views of all decks including utility spaces above dropped ceilings on the Main Deck, 01 Deck and 02 Deck are shown in Figures A.3 through A.6. The compartmentation shown represents how the ship was modeled in AutoCAD for the fire safety analysis. The compartment number in Table A-1 provides a key to the deck plan views shown in Figures A.3 through A.6.

Symbol	Description
▬	Door/Window
□	Hatch (in overhead)
○	Scuttle (in overhead)
X	XRAY - rated
Y	YOKE - rated
Z	ZEBRA - rated
W-NC	Window normally closed
NC	Door normally closed
DO	Open Doorway
Unrated hatch is open hatchway	

Figure A.1 Symbol Legend

Table A.1. VINDICATOR Compartmentation

Serial Number	Compartment Name	Plan ID Number
	Hold Lower Level	
1	FOREPEAK BALLAST TANK	4-B-0-W
2	BALLAST TANK	4-6-1-W
3	BALLAST TANK	4-6-2-W
4	FUEL OIL TANK	4-12-0-F
5	FUEL OIL TANK	4-12-1-F
6	FUEL OIL TANK	4-12-2-F
7	FUEL OIL TANK	4-18-0-F
8	SPEED LOG XDCR TRUNK	4-24-1-T
9	BALLAST TANK	4-24-2-W
10	BALLAST TANK	4-24-3-W
11	BALLAST TANK	4-24-4-W
12	TRANSDUCER TRUNK	4-31-1-T
13	MAIN GENERATOR RM	3-34-0-E
14	VOID	4-34-1-V
15	VOID	4-34-2-V
16	PROPULSION MTR RM	3-52-01-E
17	POTABLE WATER	3-52-02-W
18	FO SERV TANK	4-52-3-F
19	FO SERV TANK	4-52-4-F
20	AUXILARY POTABLE WATER	3-58-0-W
21	LO TANK	4-60-1-F
22	LO TANK	4-60-2-F
23	OILY WASTE TK	4-66-1-F
24	OILY WASTE TANK	4-66-2-F
25	TUNNEL	3-72-1-L
26	FUEL OIL TANK	4-72-1-F
27	FUEL OIL TANK	4-72-2-F
28	FUEL OIL TANK	4-72-3-F
29	FUEL OIL TANK	4-72-4-F
30	FUEL OIL TANK	4-80-1-F
31	FUEL OIL TANK	4-80-2-F
32	BALLAST TANK	4-86-1-W
33	BALLAST TANK	4-86-2-W
	Hold Upper Level	
35	BOW THRUSTER ELEC MTR RM	2-6-0-E
40	PASSAGE	2-24-0-L
41	LAUNDRY RM	2-24-1-Q
42	LAUNDRY RM	2-24-1A-Q
43	ENGR STRM	2-24-2-A
44	A/C MCHRY SPACE	2-24-4-Q
45	SEWAGE MCHRY RM	2-29-1-Q
46	SEWAGE HOLDING TANK	2-31-1-W
50	MAIN CONTROL STATION	2-52-0-C
58	ANTI-ROLL TANK	2-72-0-W
66	TUNNEL	2-86-1-L
69	STEERING GEAR RM	2-94-0-Q
70	AFTER PEAK BALLAST TANK	3-94-1-W
71	AFTER PEAK BALLAST TANK	3-94-2-W

Table A.1. VINDICATOR Compartmentation (continued)

Serial Number	Compartment Name	Plan ID Number
	Main Deck	
72	STEWARD STOREROOM	1-D-0-A
73	CHAIN LKR	1-6-1-A
74	CHAIN LKR	1-6-2-A
75	DRY PROVISIONS STRM	1-6-3-A
76	SHIP STORE	1-6-4-Q
77	PASSAGE	1-9-0-L
78	PASSAGE	1-9-0A-L
79	PASSAGE	1-9-0B-L
80	FREEZE ROOM	1-14-1-A
81	RECREATION ROOM	1-14-2-L
82	THAW ROOM	1-18-1-A
83	CHILL ROOM	1-18-3-A
84	STWY	1-22-1-L
85	EXERCISE RM	1-22-3-L
86	STWY	2-22-1-L
87	CREWS SR (3)	1-24-2-L
88	CBR LKR	1-28-2-A
89	T/S	1-28-4-L
90	HOSPITAL	1-30-1-L
91	CREWS SR (3)	1-30-2-L
92	T/S	1-32-1-L
93	WARDROOM	1-34-1-L
94	FAN ROOM	1-34-2-Q
95	UPTAKE	1-40-1-T
96	CG LKR	1-40-2-A
97	HALON CYLINDER STWG	1-40-3-A
98	UPTAKE	1-40-4-T
99	BAGGAGE STRM	1-40-6-A
100	GALLEY	1-42-1-Q
101	SCULLERY	1-44-2-Q
102	CREWS SR (6)	1-45-2-L
103	MCHRY ACCESS & REMOVAL TRUNK	1-46-1-T
104	T/S	1-48-2-L
105	CREWS MESSROOM	1-52-1-L
106	CREWS SR (3)	1-54-2-L
107	T/S	1-57-2-L
108	CREWS SR (3)	1-58-2-L
109	DC LKR	1-62-1-A
110	GENERAL WORKSHOP	1-62-3-Q
111	CREWS SR (3)	1-63-2-L
112	T/S	1-66-2-L
113	STWY	1-68-1-L
114	FAN ROOM	1-68-3-Q
115	CREWS SR (3)	1-68-2-L
116	VESTIBULE	1-72-2-L
117	D.C. SHOP	1-75-0-Q

Table A.1. VINDICATOR Compartmentation (continued)

Serial Number	Compartment Name	Plan ID Number
	Main Utility Deck	
124	MAIN DECK UTILITY SPACE NO.2	1A-14-0-Q
125	MAIN DECK UTILITY SPACE NO.1	1A-14-1-Q
128	MAIN DECK UTILITY SPACE NO.3	1A-34-1-Q
129	MAIN DECK UTILITY SPACE NO.4	1A-34-2-Q
134	MAIN DECK UTILITY SPACE NO.5	1A-42-1-Q
136	MAIN DECK UTILITY SPACE NO.7	1A-52-1-Q
	Focsle Deck	
141	BOSUN STORES	01-G-0-A
142	STRM NO 2	01-1-2-A
143	PASSAGE	01-2-0-L
144	STRM NO 1	01-2-1-A
145	EMER SWBD & GEN RM	01-6-0-Q
146	PASSAGE	01-10-0-L
147	PASSAGE	01-10-0A-L
148	PASSAGE	01-10-0B-L
149	CREW SR (2)	01-14-1-L
150	T/S	01-14-2-L
151	CREW SR (2)	01-14-4-L
152	T/S	01-17-1-L
153	CREW SR (2)	01-19-1-L
154	CREW SR (2)	01-21-2-L
155	STAIRWAY	01-22-1-L
157	CREW SR (2)	01-24-1-L
158	T/S	01-26-2-L
159	T/S	01-27-1-L
160	CREW SR (3)	01-28-2-L
161	CREW SR (2)	01-30-1-L
162	T/S	01-34-1-L
163	CREW SR (3)	01-34-2-L
164	VENT TRUNK	01-34-2A-T
165	CREW SR (3)	01-34-3-L
166	SPONSOR STRM	01-40-1-A
169	T/S	01-41-2-L
170	CREW SR (3)	01-44-2-L
171	T/S	01-46-1-L
173	CREW SR (3)	01-47-1-L
174	COMMUNICATION CTR	01-54-1-C
175	VESTIBULE	01-54-2-L
176	CG LKR	01-54-4-A
177	T/S	01-54-6-L
178	PASSENGER BERTHING (6)	01-57-2-L
179	TRAINING RM/ CREWS LOUNGE	01-61-0-L
180	PASSAGE	01-61-2-L
181	ARMORY/LAW ENFORCE. CENTER	01-64-2-K
182	ELECTRONICS & ELECTRICAL SHOP	01-68-0-Q
183	HYD. POWER RM.	01-69-1-Q

Table A.1. VINDICATOR Compartmentation (continued)

Serial Number	Compartment Name	Plan ID Number
	Focsle Utility Deck	
184	FCSLE DECK UTILITY SPACE NO.1	01A-14-1-Q
185	FCSLE DECK UTILITY SPACE NO.2	01A-14-2-Q
188	FCSLE DECK UTILITY SPACE NO.4	01A-34-0-Q
189	FCSLE DECK UTILITY SPACE NO.3	01A-34-1-Q
193	FCSLE DECK UTILITY SPACE NO.5	01A-54-1-Q
194	FCSLE DECK UTILITY SPACE NO.6	01A-54-2-Q
	Upper Deck	
195	T/S	02-14-1-L
196	EO SR	02-14-2-L
197	CO SR	02-14-3-L
198	T/S	02-18-2-L
199	PASSAGE	02-20-0-L
201	SHIP'S OFFICE & SUPPLY OFFICE	02-22-1-Q
202	XO SR	02-22-2-L
203	STAIRWAY	02-25-1-L
204	T/S	02-27-2-L
205	OFFICERS SR (2)	02-30-1-L
206	OFFICERS SR (2)	02-30-2-L
207	HW HTR LKR	02-32-2-Q
208	T/S	02-33-1-L
209	T/S	02-33-2-L
211	OPS. OFF. SR (2)	02-35-1-L
212	T/S	02-36-1-L
213	FIRST LT. SR (2)	02-37-2-L
216	T/S	02-41-2-L
217	FAN RM	02-42-1-Q
218	CG LKR	02-42-2-A
	Upper Utility Deck	
219	UPPER DECK UTILITY SPACE NO.1	02A-14-0-Q
220	UPPER DECK UTILITY SPACE NO.2	02A-22-1-Q
	Bridge Deck	
226	PILOT HOUSE	03-15-0-C
227	TOILET	03-28-1-L

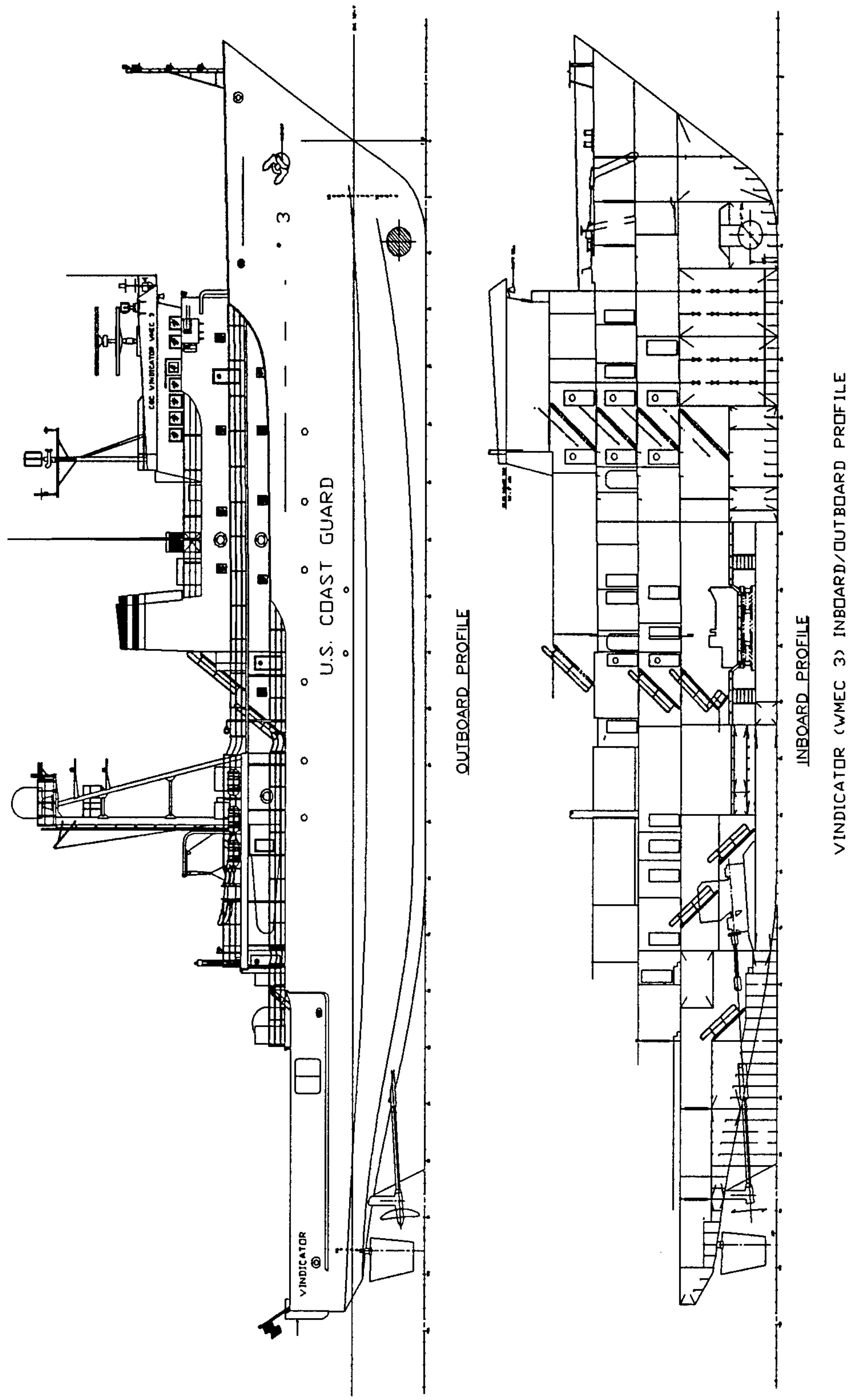

Figure A.2 VINDICATOR Inboard and Outboard Profile

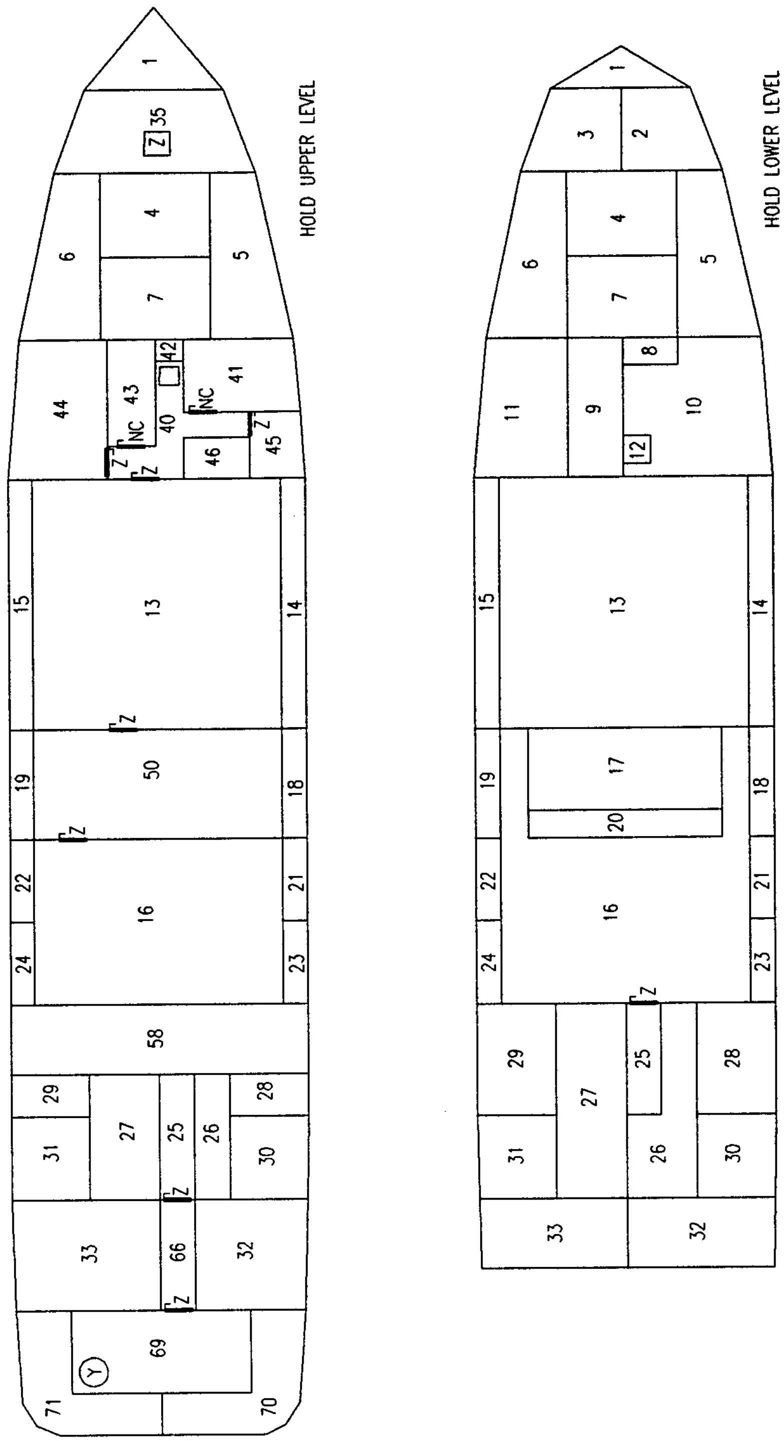

Figure A.3 VINDICATOR Hold Lower Level and Hold Upper Level

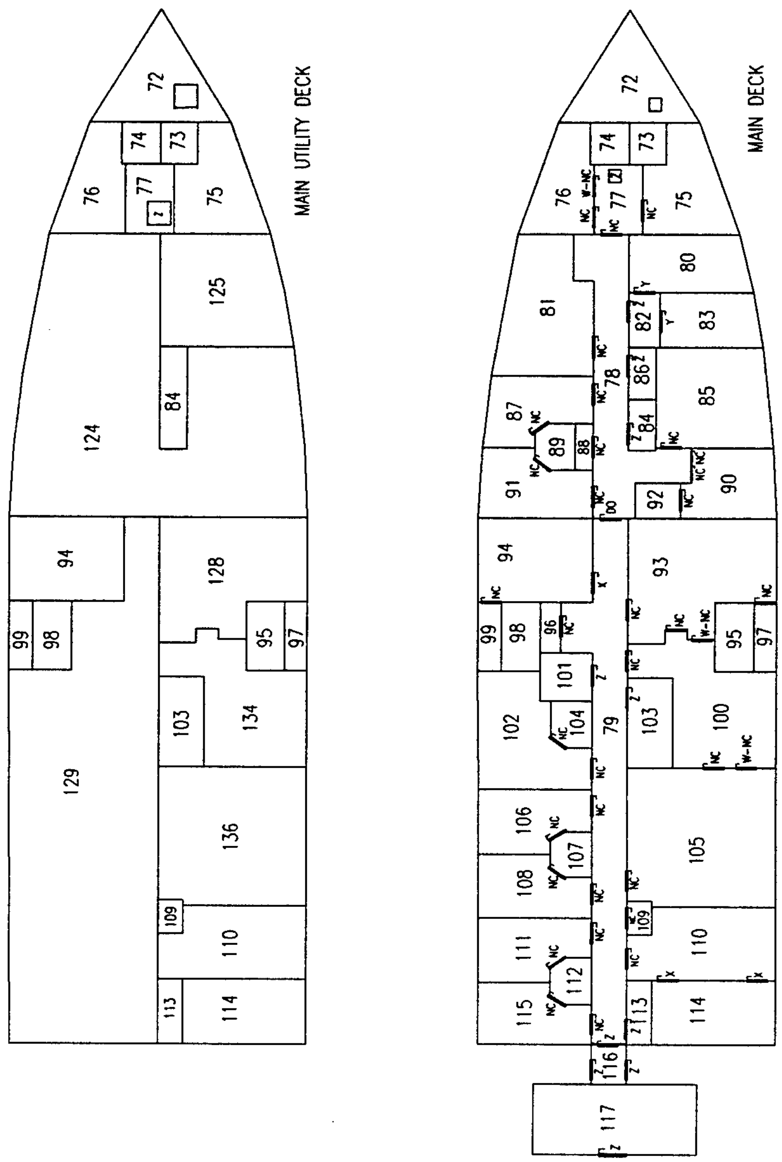

Figure A.4 VINDICATOR Main Deck and Main Utility Deck

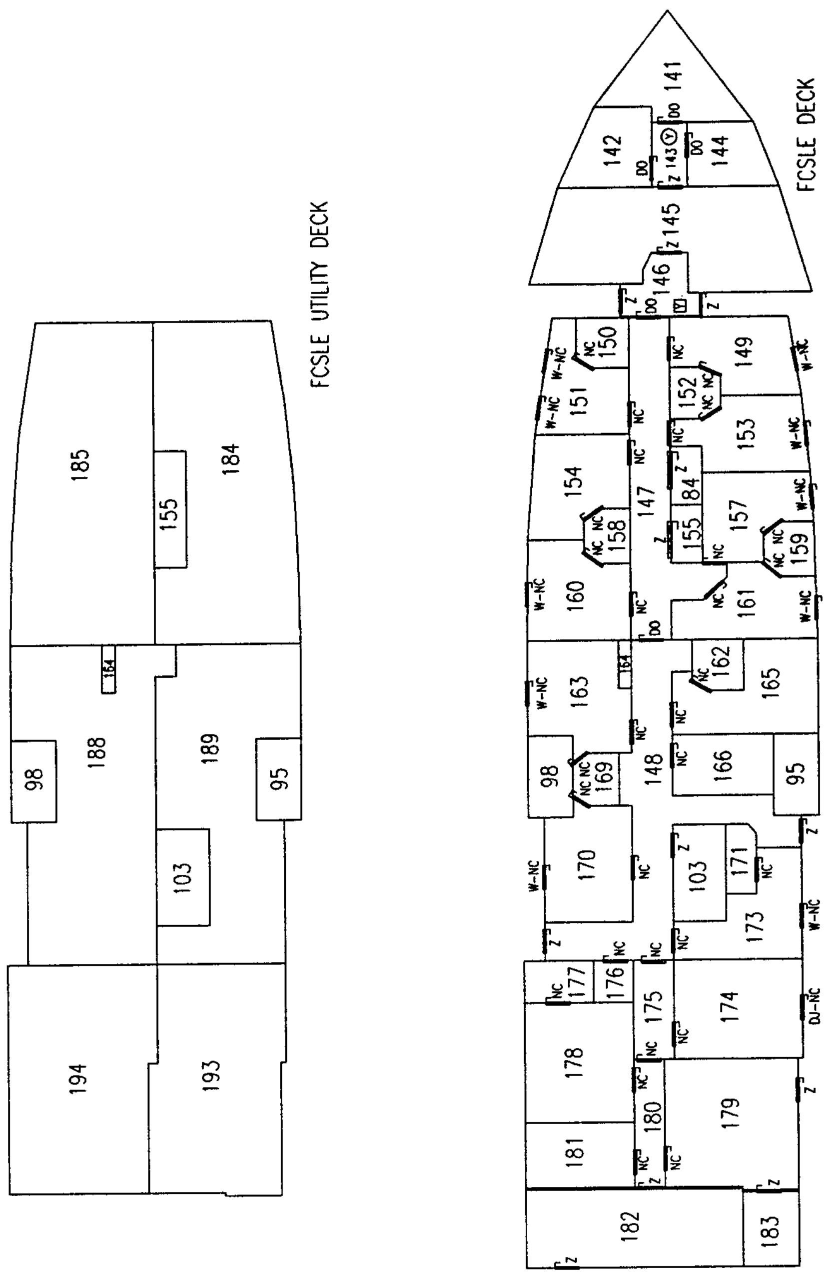

Figure A.5 VINDICATOR Fcsle Deck and Fcsle Utility Deck

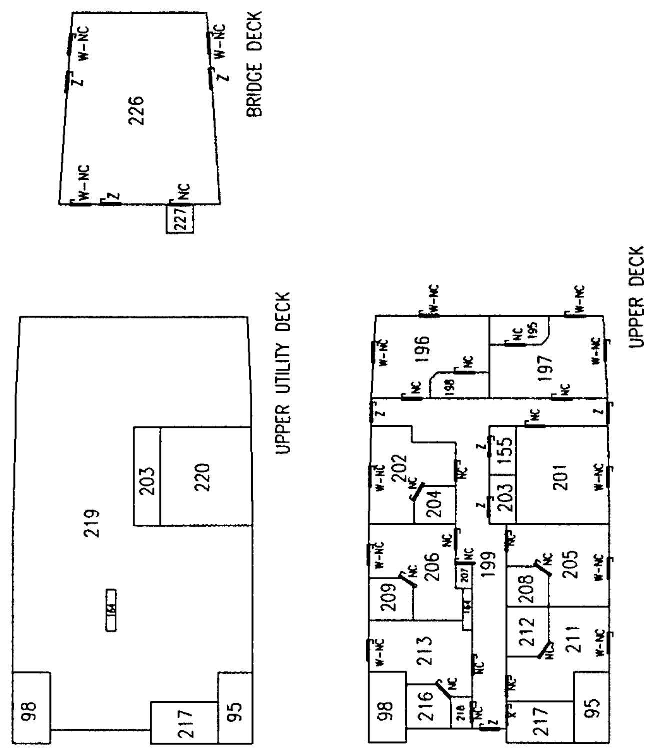

Figure A.6 VINDICATOR Upper Deck, Upper Utility Deck and Bridge Deck

Appendix B

BASELINE INPUT DATA

The various input data required to perform a fire safety analysis on the U.S. Coast Guard Coastal Cutter VINDICATOR using SAFE is documented in this Appendix. The input data is organized by category of information into eight major sections. At the beginning of each section the sources of the data are documented as well as the assumptions when complete information was not available.

The following is an index of the sections contained in this Appendix:

B.1 GEOMETRY

- Compartment Height and Deck Area
- Ventilation Openings: Area and Average Height

SOURCES

- The compartment height and deck area, as well as the location of doors and hatches, and the size of the hatches was determined from ships' drawings, References A, and B, and C.
- Damage Control ratings for doors and hatches were assigned in accordance with Table 079-9 of Reference D and Section II.A.2 of Reference E for guidance.
- Ventilation area and height was determined using engineering judgment and Chapter IV, Section C.3.3.3 of Reference F for guidance.

ASSUMPTIONS

- Each joiner door containing a louvered vent is assigned an effective vent area of 195 inches^2. and a height of 15 inches based on measurements taken during the ship visit. All joiner doors are assumed to have a one inch high by 30 inch wide clearance space at the sill.
- Doors for weathertight applications such as those in the superstructure are more like watertight doors than joiner doors and have been assigned accordingly.
- The air leakage around the perimeter of the celotex dropped ceiling panels on the Main Deck, 01 Deck, 02 Deck and 03 Deck is accounted for as a horizontal vent equivalent in area to 5% of the deck area served.
- All vents with horizontal openings were considered to have a vent height equal to the compartment height regardless of their elevation in the compartment.

DATA

- Table B.1.1 contains compartment height and deck area information.
- Table B.1.2 contains information concerning individual ventilation openings in each compartment as well as cumulative ventilation opening area and average ventilation opening height.

Table B.1.1 Compartment Height and Deck Area

Plan ID	Compartment Name	Height (Ft.)	Area (Ft^2)
CUI=AG	**(Gear Locker)**		
1-6-1-A	CHAIN LKR	8.8	32.4
1-6-2-A	CHAIN LKR	8.8	33.6
1-28-2-A	CBR LKR	6.8	17.2
1-40-2-A	CG LKR	6.8	22.2
1-62-1-A	DC LKR	8.8	17.3
01-54-4-A	CG LKR	6.5	26.0
02-42-2-A	CG LKR	7.5	14.7
CUI=AR	**(Refrigerated Storage)**		
1-14-1-A	FREEZE ROOM	6.8	139.4
1-18-1-A	THAW ROOM	6.8	35.9
1-18-3-A	CHILL ROOM	6.8	110.0
CUI=AS	**(Storeroom)**		
2-24-2-A	ENGR STRM	10.0	106.4
1-D-0-A	STEWARD STOREROOM	8.8	163.2
1-6-3-A	DRY PROVISIONS STRM	8.8	157.2
1-40-3-A	HALON CYLINDER STWG	8.8	32.0
1-40-6-A	BAGGAGE STRM	8.8	34.0
01-G-0-A	BOSUN STORES	8.5	131.4
01-1-2-A	STRM NO 2	8.5	95.0
01-2-1-A	STRM NO 1	8.5	78.4
01-40-1-A	SPONSOR STRM	6.5	95.8
CUI=C	**(Ship Control/Communications)**		
2-52-0-C	MAIN CONTROL STATION	10.0	576.0
01-54-1-C	COMMUNICATION CTR	6.5	195.2
03-15-0-C	PILOT HOUSE	9.0	594.0
CUI=EE	**(Main Propulsion - Electrical)**		
3-52-01-E	PROPULSION MTR RM	15.5	864.0
CUI=EM	**(Main Propulsion - Mechanical)**		
3-34-0-E	MAIN GENERATOR RM	15.5	1296.0
2-6-0-E	BOW THRUSTER ELEC MTR RM	10.0	296.4
CUI=K	**(Hazardous Material Storage)**		
01-64-2-K	ARMORY/LAW ENFORCEMENT CENTER	6.5	111.5
CUI=L1	(Senior Officer's Cabin)		
02-14-2-L	EO SR	7.5	174.7
02-14-3-L	CO SR	7.5	171.2
02-22-2-L	XO SR	7.5	135.0
CUI=L2	**(Officer/CPO Quarters)**		
01-14-1-L	CREW SR (2)	6.5	131.0
01-14-4-L	CREW SR (2)	6.5	114.4
01-19-1-L	CREW SR (2)	6.5	129.8
01-21-2-L	CREW SR (2)	6.5	139.3
01-24-1-L	CREW SR (2)	6.5	123.7
01-30-1-L	CREW SR (2)	6.5	135.9
02-30-1-L	OFFICERS SR (2)	7.5	147.4
02-30-2-L	OFFICERS SR (2)	7.5	147.8
02-35-1-L	OPS. OFF. SR (2)	7.5	141.4
02-37-2-L	FIRST LT. SR (2)	7.5	137.2
CUI=L5	**(Crews Berthing)**		
1-24-2-L	CREWS SR (3)	6.8	126.8
1-30-2-L	CREWS SR (3)	6.8	137.5
1-45-2-L	CREWS SR (6)	6.8	211.3
1-54-2-L	CREWS SR (3)	6.8	132.9
1-58-2-L	CREWS SR (3)	6.8	132.0
1-63-2-L	CREWS SR (3)	6.8	134.0
1-68-2-L	CREWS SR (3)	6.8	129.6
01-28-2-L	CREW SR (3)	6.5	146.5
01-34-2-L	CREW SR (3)	6.5	161.3
01-34-3-L	CREW SR (3)	6.5	164.7
01-44-2-L	CREW SR (3)	6.5	156.6
01-47-1-L	CREW SR (3)	6.5	141.2
01-57-2-L	PASSENGER BERTHING (6)	6.5	201.3

Table B.1.1 Compartment Height and Deck Area (continued)

Plan ID	Compartment Name	Height (Ft.)	Area (Ft^2)
CUI=LL	(Wardroom/Mess/Lounge Areas)		
1-14-2-L	RECREATION ROOM	6.8	238.2
1-22-3-L	EXERCISE RM	6.8	226.8
1-34-1-L	WARDROOM	6.8	323.6
1-52-1-L	CREWS MESSROOM	6.8	425.1
01-61-0-L	TRAINING RM/ CREWS LOUNGE	6.5	268.4
CUI=LM	(Medical/Dental Spaces)		
1-30-1-L	HOSPITAL	6.8	128.0
CUI=LP	(Passageway/Staircase/Vestibule)		
3-72-1-L	TUNNEL	13.5	90.0
2-24-0-L	PASSAGE	10.0	135.4
2-86-1-L	TUNNEL	6.5	80.0
1-9-0-L	PASSAGE	8.8	70.0
1-9-0A-L	PASSAGE	6.8	269.2
1-9-0B-L	PASSAGE	6.8	414.0
1-22-1-L	STWY	13.0	57.6
2-22-1-L	STWY	4.5	28.8
1-68-1-L	STWY	8.8	33.8
1-72-2-L	VESTIBULE	8.8	29.0
01-2-0-L	PASSAGE	8.5	35.2
01-10-0-L	PASSAGE	8.5	60.3
01-10-0A-L	PASSAGE	6.5	228.0
01-10-0B-L	PASSAGE	6.5	339.9
01-22-1-L	STAIRWAY	13.0	57.6
01-54-2-L	VESTIBULE	6.5	61.0
01-61-2-L	PASSAGE	6.5	60.8
02-20-0-L	PASSAGE	7.5	396.5
02-25-1-L	STAIRWAY	9.5	57.6
CUI=LW	(Sanitary Spaces)		
1-28-4-L	T/S	6.8	35.5
1-32-1-L	T/S	6.8	33.0
1-48-2-L	T/S	6.8	39.0
1-57-2-L	T/S	6.8	36.9
1-66-2-L	T/S	6.8	38.2
01-14-2-L	T/S	6.5	39.7
01-17-1-L	T/S	6.5	38.1
01-26-2-L	T/S	6.5	36.6
01-27-1-L	T/S	6.5	39.6
01-34-1-L	T/S	6.5	39.6
01-41-2-L	T/S	6.5	35.9
01-46-1-L	T/S	6.5	32.8
01-54-6-L	T/S	6.5	44.7
02-14-1-L	T/S	7.5	36.4
02-18-2-L	T/S	7.5	32.9
02-27-2-L	T/S	7.5	33.5
02-33-1-L	T/S	7.5	35.0
02-33-2-L	T/S	7.5	38.8
02-36-1-L	T/S	7.5	43.4
02-41-2-L	T/S	7.5	40.4
03-28-1-L	TOILET	9.0	16.0
CUI=QA	(Aux Machinery Spaces)		
2-24-4-Q	A/C MCHRY SPACE	10.0	272.0
2-29-1-Q	SEWAGE MCHRY RM	10.0	73.9
2-94-0-Q	STEERING GEAR RM	5.0	312.0
01-69-1-Q	HYD. POWER RM.	8.5	64.4
02-32-2-Q	HW HTR LKR	7.5	8.6
CUI=QE	(Emergency Aux Generator Spaces)		
01-6-0-Q	EMER SWBD & GEN RM	8.5	366.4

Table B.1.1 Compartment Height and Deck Area (continued)

Plan ID	Compartment Name	Height (Ft.)	Area (Ft^2)
CUI=QF	(Fan Room)		
1-34-2-Q	FAN ROOM	8.8	199.2
1-68-3-Q	FAN ROOM	8.8	167.3
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2	2.0	1212.2
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	2.0	285.3
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3	2.0	323.6
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	2.0	1347.0
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5	2.0	273.0
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7	2.0	425.1
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1	2.0	626.2
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2	2.0	676.5
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4	2.0	627.7
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	2.0	540.4
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5	2.0	463.6
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6	2.0	505.3
02-42-1-Q	FAN RM	9.5	60.0
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1	2.0	1735.0
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2	2.0	197.3
CUI=QG	(Galley/Pantry/Scullery)		
1-42-1-Q	GALLEY	6.8	273.0
1-44-2-Q	SCULLERY	6.8	53.2
CUI=QL	(Laundry)		
2-24-1-Q	LAUNDRY RM	10.0	171.6
2-24-1A-Q	LAUNDRY RM	5.0	12.8
CUI=QO	(Office Spaces)		
1-6-4-Q	SHIP STORE	8.8	126.0
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	7.5	197.3
CUI=QS	(Shops)		
1-62-3-Q	GENERAL WORKSHOP	8.8	212.4
1-75-0-Q	D.C. SHOP	8.8	240.7
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	8.5	259.2
CUI=TH	(Trunks/Hoists/Dumbwaiters)		
4-24-1-T	SPEED LOG XDCR TRUNK	10.0	32.0
4-31-1-T	TRANSDUCER TRUNK	10.0	16.0
1-46-1-T	MCHRY ACCESS & REMOVAL TRUNK	17.3	85.8
01-34-2A-T	VENT TRUNK	18.0	9.6
CUI=TU	(Stacks/Engine Uptakes)		
1-40-1-T	UPTAKE	26.8	57.1
1-40-4-T	UPTAKE	26.8	57.1
CUI=V	(Voids/Cofferdams)		
4-34-1-V	VOID	20.0	129.6
4-34-2-V	VOID	20.0	129.6
CUI=W	(Water Tank (empty))		
4-B-0-W	FOREPEAK BALLAST TANK	15.0	121.2
4-6-1-W	BALLAST TANK	10.0	147.6
4-6-2-W	BALLAST TANK	10.0	148.8
4-24-2-W	BALLAST TANK	10.0	160.0
4-24-3-W	BALLAST TANK	10.0	368.0
4-24-4-W	BALLAST TANK	10.0	254.0
3-52-02-W	POTABLE WATER	4.0	336.0
3-58-0-W	AUXILARY POTABLE WATER	4.0	112.0
4-86-1-W	BALLAST TANK	11.0	259.2
4-86-2-W	BALLAST TANK	11.0	339.2
2-31-1-W	SEWAGE HOLDING TANK	10.0	57.6
2-72-0-W	ANTI-ROLL TANK	6.5	430.0
3-94-1-W	AFTER PEAK BALLAST TANK	5.0	202.1
3-94-2-W	AFTER PEAK BALLAST TANK	5.0	204.6

Table B.1.2 Ventilation Openings: Area and Average Height

Plan ID	Compartment Name / Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
CUI=AG	(Gear Locker)						
1-6-1-A	CHAIN LKR					0	0
1-6-2-A	CHAIN LKR					0	0
1-28-2-A	CBR LKR					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
1-40-2-A	CG LKR					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
1-62-1-A	DC LKR					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
01-54-4-A	CG LKR					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
02-42-2-A	CG LKR					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
CUI=AR	(Refrigerated Storage)						
1-14-1-A	FREEZE ROOM					0	0
1-18-1-A	THAW ROOM					0	0
1-18-3-A	CHILL ROOM					0	0
CUI=AS	(Storeroom)						
2-24-2-A	ENGR STRM					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
1-D-0-A	STEWARD STOREROOM					0	0
1-6-3-A	DRY PROVISIONS STRM					325	40
	Joiner Door, NC -Sill Space	1	V	30	1		
	Joiner Door, NC -Louver	1	V	195	15		
	Supply Duct	1	H	100	105		
1-40-3-A	HALON CYLINDER STWG					48	36
	Joiner Door, NC -Sill Space	1	V	30	1		
	Retutn Dect	1	V	9	3		
	Supply Decu	1	H	9	105		
1-40-6-A	BAGGAGE STRM					0	0
01-G-0-A	BOSUN STORES					0	0
01-1-2-A	STRM NO 2					225	8
	Joiner Door, NC -Sill Space	1	V	30	1		
	Joiner Door, NC -Louver	1	V	195	15		
01-2-1-A	STRM NO 1					257	6
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Supply Duct	2	V	16	4		
01-40-1-A	SPONSOR STRM					261	31
	Supply Duct	1	H	36	78		
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
CUI=C	(Ship Control/Communications)						
2-52-0-C	MAIN CONTROL STATION					1224	84
	Supply Duct	4	H	162	120		
	Exhaust Duct	2	V	288	12		
01-54-1-C	COMMUNICATION CTR					1435	39
	Joiner Door, NC -Sill Space	1	V	30	1		
	Ceiling Joints	1	H	1405	78		
03-15-0-C	PILOT HOUSE					865	79
	Supply Duct	4	H	100	108		
	Exhaust Duct	1	H	240	108		
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
CUI=EE	(Main Propulsion - Electrical)						
3-52-01-E	PROPULSION MTR RM					1890	117
	Supply Duct	2	H	144	186		
	Supply Duct	2	V	225	15		
	Exhaust Duct	1	H	1152	186		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name	Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
CUI=EM	(Main Propulsion - Mechanical)							
3-34-0-E	MAIN GENERATOR RM						3088	76
		Supply Duct	6	V	312	24		
		Supply Duct	4	H	196	186		
		Supply Duct	2	V	216	12		
2-6-0-E	BOW THRUSTER ELEC MTR RM						192	120
		Exhaust Duct	1	H	128	120		
		Supply Duct	1	H	64	120		
CUI=K	(Hazardous Material Storage)							
01-64-2-K	ARMORY/LAW ENFORCEMENT CENTER						225	8
		Joiner Door, NC -Sill Space	1	V	30	1		
		Joiner Door, NC-Louver	1	V	195	15		
CUI=L1	(Senior Officer's Cabin)							
02-14-2-L	EO SR						1808	35
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	90		
		Ceiling Joints	1	H	1258	90		
02-14-3-L	CO SR						1782	35
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	90		
		Ceiling Joints	1	H	1232	90		
02-22-2-L	XO SR						2522	35
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	90		
		Ceiling Joints	1	H	1972	90		
CUI=L2	(Officer/CPO Quarters)							
01-14-1-L	CREW SR (2)						1493	31
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	78		
		Ceiling Joints	1	H	943	78		
01-14-4-L	CREW SR (2)						1373	31
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	78		
		Ceiling Joints	1	H	823	78		
01-19-1-L	CREW SR (2)						1485	31
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	78		
		Ceiling Joints	1	H	935	78		
01-21-2-L	CREW SR (2)						1552	31
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	78		
		Ceiling Joints	1	H	1002	78		
01-24-1-L	CREW SR (2)						1441	31
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	78		
		Ceiling Joints	1	H	891	78		
01-30-1-L	CREW SR (2)						1528	31
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	100	78		
		Ceiling Joints	1	H	978	78		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name / Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
02-30-1-L	OFFICERS SR (2)					1610	35
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	90		
	Ceiling Joints	1	H	1060	90		
02-30-2-L	OFFICERS SR (2)					1614	35
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	90		
	Ceiling Joints	1	H	1064	90		
02-35-1-L	OPS. OFF. SR (2)					1568	35
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	90		
	Ceiling Joints	1	H	1018	90		
02-37-2-L	FIRST LT. SR (2)					1538	35
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	90		
	Ceiling Joints	1	H	988	90		
CUI=L5	**(Crews Berthing)**						
1-24-2-L	CREWS SR (3)					1463	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	913	81		
1-30-2-L	CREWS SR (3)					1540	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	990	81		
1-45-2-L	CREWS SR (6)					2072	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	1522	81		
1-54-2-L	CREWS SR (3)					1507	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	957	81		
1-58-2-L	CREWS SR (3)					1501	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	951	81		
1-63-2-L	CREWS SR (3)					1515	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	965	81		
1-68-2-L	CREWS SR (3)					1483	32
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	933	81		
01-28-2-L	CREW SR (3)					1606	31
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1056	78		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name / Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
01-34-2-L	CREW SR (3)					1712	31
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1162	78		
01-34-3-L	CREW SR (3)					1736	31
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1186	78		
01-44-2-L	CREW SR (3)					1678	31
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1128	78		
01-47-1-L	CREW SR (3)					1566	31
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1016	78		
01-57-2-L	PASSENGER BERTHING (6)					2000	31
	Joiner Door, NC -Louver	2	V	195	15		
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1450	78		
CUI=LL	**(Wardroom/Mess/Lounge Areas)**						
1-14-2-L	RECREATION ROOM					2041	44
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	1716	81		
1-22-3-L	EXERCISE RM					1959	44
	Joiner Door, NC -Sill Space	1	V	30	1		
	Joiner Door, NC -Louver	1	V	195	15		
	Supply Duct	1	H	100	81		
	Ceiling Joints	1	H	1634	81		
1-34-1-L	WARDROOM					2592	41
	Joiner Door, NC -Sill Space	3	V	30	1		
	Supply Duct	1	H	100	81		
	Supply Duct	1	H	72	81		
	Ceiling Joints	1	H	2330	81		
1-52-1-L	CREWS MESSROOM					3545	37
	Supply Duct	2	H	100	81		
	Joiner Door, NC -Sill Space	3	V	30	1		
	Joiner Door, NC -Louver	1	V	195	15		
	Ceiling Joints	1	H	3060	81		
01-61-0-L	TRAINING RM/ CREWS LOUNGE					2257	43
	Joiner Door, NC -Sill Space	1	V	30	1		
	Joiner Door, NC -Louver	1	V	195	15		
	Supply Duct	1	H	100	78		
	Ceiling Joints	1	H	1932	78		
CUI=LM	**(Medical/Dental Spaces)**						
1-30-1-L	HOSPITAL					1331	37
	Joiner Door, NC -Sill Space	3	V	30	1		
	Joiner Door, NC -Louver	1	V	195	15		
	Supply Duct	1	H	100	81		
	Ceiling Joints	2	H	473	81		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name	Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
CUI=LP	**(Passageway/Staircase/Vestibule)**							
3-72-1-L	TUNNEL						18	82
		Supply Duct	1	H	9	162		
		Return Duct	1	V	9	3		
2-24-0-L	PASSAGE						120	1
		Joiner Door, NC -Sill Space	4	V	30	1		
2-86-1-L	TUNNEL						0	0
1-9-0-L	PASSAGE						954	27
		Joiner Door, NC -Sill Space	2	V	30	1		
		Joiner Door, NC -Louver	2	V	195	15		
		Ceiling Joints	1	H	504	105		
1-9-0A-L	PASSAGE						2898	13
		Joiner Door, NC -Sill Space	6	V	30	1		
		Joiner Door, NC -Louver	4	V	195	15		
		Ceiling Joints	1	H	1938	81		
1-9-0B-L	PASSAGE						5596	14
		Joiner Door, NC -Sill Space	11	V	30	1		
		Joiner Door, NC -Louver	9	V	195	15		
		Return Louver	1	V	391	17		
		Ceiling Joints	2	H	1560	81		
1-22-1-L	STWY						0	0
2-22-1-L	STWY						0	0
1-68-1-L	STWY						0	0
1-72-2-L	VESTIBULE						0	0
01-2-0-L	PASSAGE						241	6
		Joiner Door, NC -Sill Space	1	V	30	1		
		Joiner Door, NC -Louver	1	V	195	15		
		Supply Duct	1	V	16	4		
01-10-0-L	PASSAGE						434	102
		Ceiling Joints	1	H	434	102		
01-10-0A-L	PASSAGE						3217	12
		Joiner Door, NC -Sill Space	7	V	30	1		
		Joiner Door, NC -Louver	7	V	195	15		
		Ceiling Joints	1	H	1642	78		
01-10-0B-L	PASSAGE						3927	17
		Joiner Door, NC -Louver	4	V	195	15		
		Joiner Door, NC -Sill Space	7	V	30	1		
			1	V	345	23		
		Ceiling Joints	2	H	1296	78		
01-22-1-L	STAIRWAY						0	0
01-54-2-L	VESTIBULE						469	39
		Ceiling Joints	1	H	439	78		
		Joiner Door, NC -Sill Space	1	V	30	1		
01-61-2-L	PASSAGE						438	78
		Ceiling Joints	1	H	438	78		
02-20-0-L	PASSAGE						5187	18
		Joiner Door, NC -Sill Space	10	V	30	1		
		Joiner Door, NC -Louver	9	V	195	15		
		Joiner Door, NC -Sill Space	1	V	24	2		
		Ceiling Joints	3	H	1036	90		
02-25-1-L	STAIRWAY						0	0
CUI=LW	**(Sanitary Spaces)**							
1-28-4-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	81		
1-32-1-L	T/S						231	32
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	81		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name	Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
1-48-2-L	T/S						231	32
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	81		
1-57-2-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	81		
1-66-2-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	81		
01-14-2-L	T/S						231	31
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	78		
01-17-1-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	78		
01-26-2-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	78		
01-27-1-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	78		
01-34-1-L	T/S						231	31
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	78		
01-41-2-L	T/S						456	22
		Joiner Door, NC -Louver	2	V	195	15		
		Joiner Door, NC -Sill Space	2	V	30	1		
		Supply Duct	1	H	6	78		
01-46-1-L	T/S						231	31
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	78		
01-54-6-L	T/S						231	31
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	78		
02-14-1-L	T/S						231	35
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	90		
02-18-2-L	T/S						231	35
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	90		
02-27-2-L	T/S						231	35
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	90		
02-33-1-L	T/S						231	35
		Joiner Door, NC -Louver	1	V	195	15		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	6	90		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name / Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
02-33-2-L	T/S					231	35
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Supply Duct	1	H	6	90		
02-36-1-L	T/S					231	35
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Supply Duct	1	H	6	90		
02-41-2-L	T/S					231	35
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Supply Duct	1	H	6	90		
03-28-1-L	TOILET					231	41
	Joiner Door, NC -Louver	1	V	195	15		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Supply Duct	1	H	6	108		
CUI=QA	**(Aux Machinery Spaces)**						
2-24-4-Q	A/C MCHRY SPACE					1182	16
	Supply/Exhaust Ducts	2	V	576	24		
	Joiner Door, NC -Sill Space	1	V	30	1		
2-29-1-Q	SEWAGE MCHRY RM					57	61
	Supply Duct	2	H	9	120		
	Return Duct	1	V	9	3		
	Joiner Door, NC -Sill Space	1	V	30	1		
2-94-0-Q	STEERING GEAR RM					765	37
	Supply Duct	1	V	225	15		
	Return Pipe	1	H	540	60		
01-69-1-Q	HYD. POWER RM.					231	43
	Return Louver	1	V	120	10		
	Supply Duct	2	H	36	102		
	Joiner Door, NC -Sill Space	1	V	30	1		
	Return Duct	1	V	9	3		
02-32-2-Q	HW HTR LKR					30	1
	Joiner Door, NC -Sill Space	1	V	30	1		
CUI=QE	**(Emergency Aux Generator Spaces)**						
01-6-0-Q	EMER SWBD & GEN RM					3164	20
	Joiner Door, NC -Sill Space	2	V	30	1		
	Supply Louver	1	V	2030	70		
	Exhaust Duct	1	V	224	16		
	Exhaust Duct	2	V	425	17		
CUI=QF	**(Fan Room)**						
1-34-2-Q	FAN ROOM					535	61
	Return Louver	1	V	391	17		
	Supply Duct	1	H	144	105		
1-68-3-Q	FAN ROOM					364	56
	Return Louver	1	V	196	7		
	Supply Duct	1	H	168	105		
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2					8730	24
	Ceiling Joints	1	H	8730	24		
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1					2055	24
	Ceiling Joints	1	H	2055	24		
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3					2330	24
	Ceiling Joints	1	H	2330	24		
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4					9770	24
	Ceiling Joints	1	H	9770	24		
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5					1965	24
	Ceiling Joints	1	H	1965	24		
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7					3060	24
	Ceiling Joints	1	H	3060	24		
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1					4510	24
	Ceiling Joints	1	H	4510	24		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name	Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2						4870	24
		Ceiling Joints	1	H	4870	24		
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4						4520	24
		Ceiling Joints	1	H	4520	24		
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3						3890	24
		Ceiling Joints	1	H	3890	24		
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5						3368	24
		Ceiling Joints	1	H	3368	24		
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6						3640	24
		Ceiling Joints	1	H	3640	24		
02-42-1-Q	FAN RM						773	63
		Supply Duct	1	V	221	13		
		Return Louver	1	H	552	114		
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1						12570	16
		Return Louver	1	V	96	8		
		Ceiling Joints	1	H	12474	24		
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2						1420	24
		Ceiling Joints	1	H	1420	24		
CUI=QG	**(Galley/Pantry/Scullery)**							
1-42-1-Q	GALLEY						652	13
		Joiner Door, NC -Sill Space	5	V	30	1		
		Supply Duct	1	H	91	81		
		Joiner Door, NC -Louver	1	V	195	15		
		Return Louver	1	V	216	3		
1-44-2-Q	SCULLERY						130	41
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	H	100	81		
CUI=QL	**(Laundry)**							
2-24-1-Q	LAUNDRY RM						283	63
		Joiner Door, NC -Sill Space	1	V	30	1		
		Return Louver	1	V	104	13		
		Supply Duct	1	H	100	120		
		Supply Duct	1	H	49	120		
2-24-1A-Q	LAUNDRY RM						0	0
CUI=QO	**(Office Spaces)**							
1-6-4-Q	SHIP STORE						373	30
		Joiner Door, NC -Sill Space	1	V	30	1		
		Joiner Door, NC -Louver	1	V	195	15		
		Return Louver	1	V	48	1		
		Supply Duct	1	H	100	105		
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE						1574	45
		Joiner Door, NC -Sill Space	1	V	30	1		
		Return Louver	1	V	24	2		
		Supply Duct	1	H	100	90		
		Ceiling Joints	1	H	1420	90		
CUI=QS	**(Shops)**							
1-62-3-Q	GENERAL WORKSHOP						267	29
		Joiner Door, NC -Sill Space	1	V	30	1		
		Return Louver	1	V	128	8		
		Return Duct	1	V	9	3		
		Supply Duct	1	H	100	105		
1-75-0-Q	D.C. SHOP						209	7
		Supply Duct	2	V	100	10		
		Return Duct	1	V	9	3		
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP						1941	28
		Return Louver	1	V	36	6		
		Joiner Door, NC -Sill Space	1	V	30	1		
		Supply Duct	1	V	9	3		
		Ceiling Joints	1	H	1866	102		

Table B.1.2 Ventilation Openings: Area and Average Height (continued)

Plan ID	Compartment Name	Type	# Vents	H/V	Area (In^2)	Height (In.)	Total Area (In^2)	Avg.Height (In.)
CUI=TH	**(Trunks/Hoists/Dumbwaiters)**							
4-24-1-T	SPEED LOG XDCR TRUNK						0	0
4-31-1-T	TRANSDUCER TRUNK						0	0
1-46-1-T	MCHRY ACCESS & REMOVAL TRUNK						0	0
01-34-2A-T	VENT TRUNK						0	0
CUI=TU	**(Stacks/Engine Uptakes)**							
1-40-1-T	UPTAKE						4320	72
		Return Louver	1	V	4320	72		
1-40-4-T	UPTAKE						4320	72
		Return Louver	1	V	4320	72		
CUI=V	**(Voids/Cofferdams)**							
4-34-1-V	VOID						0	0
4-34-2-V	VOID						0	0
CUI=W	**(Water Tank (empty))**							
4-B-0-W	FOREPEAK BALLAST TANK						0	0
4-6-1-W	BALLAST TANK						0	0
4-6-2-W	BALLAST TANK						0	0
4-24-2-W	BALLAST TANK						0	0
4-24-3-W	BALLAST TANK						0	0
4-24-4-W	BALLAST TANK						0	0
3-52-02-W	POTABLE WATER						0	0
3-58-0-W	AUXILARY POTABLE WATER						0	0
4-86-1-W	BALLAST TANK						0	0
4-86-2-W	BALLAST TANK						0	0
2-31-1-W	SEWAGE HOLDING TANK						0	0
2-72-0-W	ANTI-ROLL TANK						0	0
3-94-1-W	AFTER PEAK BALLAST TANK						0	0
3-94-2-W	AFTER PEAK BALLAST TANK						0	0

H/V = Horizontal or Vertical
Vent Height for Horizontal Vents = Compartment Height

B.2 CONSTRUCTION MATERIALS

- Hull, Bulkheads and Decks/Overheads
- Insulation
- T-Adjust and D-Adjust Values

SOURCES

- Hull, bulkhead and deck/overhead material were determined using References A, B, C, G, and H and the table of Barrier Materials from Reference F included here as Attachment B.2.1.
- Access fittings such as doors, hatches, scuttles and windows were assigned an appropriate damage control rating (XRAY, YOKE, ZEBRA, etc.) in accordance with guidance in Reference D.
- T-adjust and D-adjust values were assigned using engineering judgment in accordance with the guidance provided in Chapter IV, Section C.3.2 of Reference F.

ASSUMPTIONS

- Hull material is considered 3/8" thick plate. The interior surfaces of the hull were assigned an insulated bulkhead rating of the same (steel) thickness as the hull material so that SAFE could account for the insulation present.
- Deck material is considered 1/4" thick steel.
- Decks which may be covered with a poured surface and/or tiled, such as the Galley, Scullery and Laundry Room, were assigned a SAFE rating of D06 vs. D05 because D05 values listed in Attachment B.2.1 are not considered valid for this application.

DATA

- Table B.2.1 contains all relevant information concerning barrier data. Barriers are assigned on the compartment side (<1>), the adjacent room side (<3>) and in between as the case of watertight bulkheads between joiner bulkheads on either side. T-adjust and D-adjust values are assigned for each barrier. Existing access fittings and their associated damage control rating are assigned to the barriers they are installed in and shown in Table B.2.1. Doors are designated as: DWT (watertight door) and DJ (joiner door); hatches are either HO (open hatchway), HS (small hatch/scuttle), or HL (large hatch).

Attachment B.2.1 Barrier Materials

The table below describes the thermal and physical characteristics of the barrier materials available in the SAFE database. The compartment summary sheets in Appendix C refer to barrier materials by their material ID code as shown in this table.

Material ID	Description	Thickness (m)	Density (kg/m^3)	Specific Heat (J/kg)	Thermal Cond. (W/mDegK)	Heat (%)	tbar (kBTU/sq ft) x1	tbar x2	tbar x3	dbar (kBTU/sq ft) x1	dbar x2	dbar x3
Bulkhead	**Materials:**											
B00	Zero Strength bulkhead	0.0001	0	0	9999.00	100	0	0	0	0	0	0
B01	Expanded metal "screening"	0.0001	0	0	9999.00	80	0	0	0	0	0	0
B02	Nomex honeycomb core -plastic laminate both sides	0.0174	48	1210	0.07	30	2	6	14	3	12	20
B03	Nomex honeycomb core -stainless steel both sides	0.0174	50	1210	0.08	25	8	20	30	55	80	105
B04	Nomex honeycomb core -plastic laminate & thermal insulation	0.0510	50	1210	0.04	30	2	8	10	9	18	22
B05	Steel Joiner	0.0064	7840	500	45.30	5	1	4	10	60	80	100
B06	Steel Joiner with thermal insulation	0.0510	7800	100	1.00	5	5	15	18	75	100	120
B07	Aluminum structural bulkhead (5086)	0.0060	2657	963	126.34	15	0	3	5	4	8	12
B08	Aluminum structural bulkhead w/ thermal insulation	0.0500	2600	200	5.00	5	3	6	10	3	6	10
B09	Structural steel	0.0104	7840	500	45.30	5	1	5	12	70	90	110
B10	Structural steel w/ thermal insulation	0.0510	7800	100	1.00	5	6	18	20	80	110	130
BOF	1/4" Fiberglass toilet/shower enclosure	0.0063	1380	960	0.15	35	2	5	7	25	35	40
BOP	7/8" Plywood-plastic laminate facing, both sides	0.0222	540	1215	0.12	15	6	12	21	10	20	27
Overhead	**/Deck Materials**											
D00	Zero strength overhead/deck	0.0001	0	0	9999.00	100	0	0	0	0	0	0
D01	Aluminum grating overhead/deck	0.0001	0	0	9999.00	90	0	0	0	0	0	0
D02	Steel grating overhead/deck	0.0001	0	0	9999.00	90	0	0	0	0	0	0
D03	Aluminum overhead (5086)	0.0060	2657	963	126.34	25	0	2	4	4	6	10
D04	Steel overhead/deck	0.0127	7840	500	45.30	5	3	9	15	120	140	160
D05	Steel overhead/deck w/ poured floor or tile (1/4")	0.0191	7800	750	2.00	3	60	80	105	260	320	350
D06	Steel overhead/deck w/ thermal insulation	0.0510	7800	100	1.00	5	6	18	20	80	110	130
DOC	5/8" Celotex dropped ceiling	0.0159	24	700	0.04	25	1	3	4	1	3	4
DOF	1/4"Fiberglass tiolet/shower enclosure	0.0063	1380	960	0.15	35	2	5	7	25	35	40
Hull	**Materials:**											
H01	Aluminum shell plating (1/4")	0.0060	2657	963	126.34	15	0	3	5	4	8	12
H02	Steel shell plating (1/4")	0.0060	7840	500	45.30	5	1	4	10	60	80	100
H03	Steel shell plating (3/8")	0.0090	7840	500	45.30	5	1	4	10	65	85	105
H04	Steel shell plating (1/2")	0.0130	7840	500	45.30	5	1	4	10	70	90	110
H05	Steel shell plating (5/8")	0.0160	7840	500	45.30	5	2	5	12	75	95	115

Table B.2.1 Barrier Data

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			4-B-0-W	**FOREPEAK BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-6-1-W	BALLAST TANK	50.0	0	0		
B09	B09	B09	4-6-2-W	BALLAST TANK	51.0	0	0		
B09	B09	B09	2-6-0-E	BOW THRUSTER ELEC MT	202.0	0	0		
B09	H03		(none)	(weather bulkhead)	59.2	0	0		
B09	H03		(none)	(weather bulkhead)	58.3	0	0		
B09	H03		(none)	(weather bulkhead)	157.5	0	0		
B09	H03		(none)	(weather bulkhead)	156.2	0	0		
D04			1-D-0-A	STEWARD STOREROOM	121.2	0	0		
			4-6-1-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-B-0-W	FOREPEAK BALLAST TAN	50.0	0	0		
B05		B05	4-6-2-W	BALLAST TANK	120.0	0	0		
B09	B09	B09	4-12-0-F	FUEL OIL TANK	80.0	0	0		
B09	B09	B09	4-12-1-F	FUEL OIL TANK	66.0	0	0		
B09	H03		(none)	(weather bulkhead)	128.5	0	0		
D04			2-6-0-E	BOW THRUSTER ELEC MT	147.6	0	0		
			4-6-2-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-B-0-W	FOREPEAK BALLAST TAN	51.0	0	0		
B05		B05	4-6-1-W	BALLAST TANK	120.0	0	0		
B09	B09	B09	4-12-0-F	FUEL OIL TANK	80.0	0	0		
B09	B09	B09	4-12-2-F	FUEL OIL TANK	66.0	0	0		
B09	H03		(none)	(weather bulkhead)	127.8	0	0		
D04			2-6-0-E	BOW THRUSTER ELEC MT	148.8	0	0		
			4-24-1-T	**SPEED LOG XDCR TRUNK**	**(CUI = TH)**				
B09	B09	B09	4-18-0-F	FUEL OIL TANK	80.0	0	0		
B05		B05	4-24-2-W	BALLAST TANK	40.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	80.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	40.0	0	0		
D04			2-24-0-L	PASSAGE	3.2	0	0		
D04			2-24-1-Q	LAUNDRY RM	16.0	0	0		
D04			2-24-1A-Q	LAUNDRY RM	12.8	0	0		
			4-24-2-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-18-0-F	FUEL OIL TANK	80.0	0	0		
B05		B05	4-24-1-T	SPEED LOG XDCR TRUNK	40.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	20.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	100.0	0	0		
B05		B05	4-24-4-W	BALLAST TANK	200.0	0	0		
B05		B05	4-31-1-T	TRANSDUCER TRUNK	40.0	0	0		
B09	B09	B10	3-34-0-E	MAIN GENERATOR RM	44.0	0	0		
D04			2-24-0-L	PASSAGE	33.6	0	0		
D04			2-24-2-A	ENGR STRM	106.4	0	0		
D04			2-24-4-Q	A/C MCHRY SPACE	20.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			4-24-3-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-12-1-F	FUEL OIL TANK	120.0	0	0		
B05		B05	4-24-1-T	SPEED LOG XDCR TRUNK	80.0	0	0		
B05		B05	4-24-1-T	SPEED LOG XDCR TRUNK	40.0	0	0		
B05		B05	4-24-2-W	BALLAST TANK	20	0	0		
B05		B05	4-24-2-W	BALLAST TANK	100.0	0	0		
B05		B05	4-31-1-T	TRANSDUCER TRUNK	40	0	0		
B05		B05	4-31-1-T	TRANSDUCER TRUNK	40.0	0	0		
B05		B05	4-31-1-T	TRANSDUCER TRUNK	40.0	0	0		
B09	B09	B10	3-34-0-E	MAIN GENERATOR RM	99.0	0	0		
B09	B09	B09	4-34-1-V	VOID	36.0	0	0		
B09	H03		(none)	(weather bulkhead)	200.6	0	0		
D04			2-24-0-L	PASSAGE	82.6	0	0		
D04			2-24-1-Q	LAUNDRY RM	154.7	0	0		
D04			2-29-1-Q	SEWAGE MCHRY RM	73.1	0	0		
D04			2-31-1-W	SEWAGE HOLDING TANK	57.6	0	0		
			4-24-4-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-12-2-F	FUEL OIL TANK	118.0	0	0		
B05		B05	4-24-2-W	BALLAST TANK	200.0	0	0		
B09	B09	B10	3-34-0-E	MAIN GENERATOR RM	55.0	0	0		
B09	B09	B09	4-34-2-V	VOID	36.0	0	0		
B09	H03		(none)	(weather bulkhead)	200.8	0	0		
D04			2-24-4-Q	A/C MCHRY SPACE	252.0	0	0		
			4-31-1-T	**TRANSDUCER TRUNK**	**(CUI = TH)**				
B05		B05	4-24-2-W	BALLAST TANK	40.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	40.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	40.0	0	0		
B05		B05	4-24-3-W	BALLAST TANK	40.0	0	0		
D04			2-24-0-L	PASSAGE	16.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			3-34-0-E	**MAIN GENERATOR RM**	**(CUI = EM)**				
B10	B09	B09	4-24-2-W	BALLAST TANK	44.0	0	0		
B10	B09	B09	4-24-3-W	BALLAST TANK	99.0	0	0		
B10	B09	B09	4-24-4-W	BALLAST TANK	55.0	0	0		
B06		B05	4-34-1-V	VOID	198.0	0	0		
B06		B05	4-34-1-V	VOID	360.0	0	0		
B06		B05	4-34-2-V	VOID	198.0	0	0		
B06		B05	4-34-2-V	VOID	360.0	0	0		
B10	B09	B10	3-52-01-E	PROPULSION MTR RM	22.0	0	0		
B10	B09	B10	3-52-01-E	PROPULSION MTR RM	22.0	0	0		
B10	B09	B09	3-52-02-W	POTABLE WATER	112.0	0	0		
B06	B09	B10	2-24-0-L	PASSAGE	110.0	0	0	DWT	Z
B09	B09	B10	2-24-4-Q	A/C MCHRY SPACE	110.0	0	0		
B09	B09	B09	2-29-1-Q	SEWAGE MCHRY RM	44.0	0	0		
B06	B09	B05	2-31-1-W	SEWAGE HOLDING TANK	96.0	0	0		
B10	B09	B10	2-52-0-C	MAIN CONTROL STATION	360.0	0	0	DWT	Z
D06			1-9-0B-L	PASSAGE	214.0	0	0		
D06			1-34-1-L	WARDROOM	282.8	0	0		
D06			1-34-2-Q	FAN ROOM	156.0	0	0		
D00			1-40-1-T	UPTAKE	54.0	0	0		
D06			1-40-2-A	CG LKR	22.2	0	0		
D00			1-40-4-T	UPTAKE	54.0	0	0		
D06			1-42-1-Q	GALLEY	225.4	0	0		
D06			1-44-2-Q	SCULLERY	53.2	0	0		
D06			1-45-2-L	CREWS SR (6)	109.5	0	0		
D00			1-46-1-T	MCHRY ACCESS & REMOV	85.8	0	0		
D06			1-48-2-L	T/S	39.0	0	0		
			4-34-1-V	**VOID**	**(CUI = V)**				
B09	B09	B09	4-24-3-W	BALLAST TANK	36.0	0	0		
B05		B06	3-34-0-E	MAIN GENERATOR RM	198.0	0	0		
B05		B06	3-34-0-E	MAIN GENERATOR RM	360.0	0	0		
B09	B09	B09	4-52-3-F	FO SERV TANK	36.0	0	0		
B09	B09	B09	4-52-3-F	FO SERV TANK	36.0	0	0		
B09	B09	B10	2-29-1-Q	SEWAGE MCHRY RM	36.0	0	0		
B09	H03		(none)	(weather bulkhead)	360.0	0	0		
B09	H03		(none)	(weather bulkhead)	360.0	0	0		
D04			1-34-1-L	WARDROOM	40.8	0	0		
D04			1-40-3-A	HALON CYLINDER STWG	32.0	0	0		
D04			1-42-1-Q	GALLEY	47.6	0	0		
			4-34-2-V	**VOID**	**(CUI = V)**				
B09	B09	B09	4-24-4-W	BALLAST TANK	36.0	0	0		
B05		B06	3-34-0-E	MAIN GENERATOR RM	198.0	0	0		
B05		B06	3-34-0-E	MAIN GENERATOR RM	360.0	0	0		
B09	B09	B09	4-52-4-F	FO SERV TANK	36.0	0	0		
B09	B09	B09	4-52-4-F	FO SERV TANK	34.0	0	0		
B09	B09	B10	2-24-4-Q	A/C MCHRY SPACE	34.0	0	0		
B09	H03		(none)	(weather bulkhead)	360.0	0	0		
B09	H03		(none)	(weather bulkhead)	360.0	0	0		
D04			1-34-2-Q	FAN ROOM	40.8	0	0		
D04			1-40-6-A	BAGGAGE STRM	32.0	0	0		
D04			1-45-2-L	CREWS SR (6)	47.6	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			3-52-01-E	**PROPULSION MTR RM**	**(CUI = EE)**				
B10	B09	B10	3-34-0-E	MAIN GENERATOR RM	22.0	0	0		
B10	B09	B10	3-34-0-E	MAIN GENERATOR RM	22.0	0	0		
B06		B05	3-52-02-W	POTABLE WATER	48.0	0	0		
B06		B05	3-52-02-W	POTABLE WATER	48.0	0	0		
B06		B05	4-52-3-F	FO SERV TANK	88.0	0	0		
B06		B05	4-52-4-F	FO SERV TANK	88.0	0	0		
B06		B05	3-58-0-W	AUXILARY POTABLE WAT	16.0	0	0		
B06		B05	3-58-0-W	AUXILARY POTABLE WAT	112.0	0	0		
B06		B05	3-58-0-W	AUXILARY POTABLE WAT	16.0	0	0		
B06		B05	4-60-1-F	LO TANK	66.0	0	0		
B05		B05	4-60-1-F	LO TANK	120.0	0	0		
B06		B05	4-60-2-F	LO TANK	66.0	0	0		
B05		B05	4-60-2-F	LO TANK	120.0	0	0		
B06		B05	4-66-1-F	OILY WASTE TK	66.0	0	0		
B05		B05	4-66-1-F	OILY WASTE TK	120.0	0	0		
B06		B05	4-66-2-F	OILY WASTE TANK	66.0	0	0		
B05		B05	4-66-2-F	OILY WASTE TANK	120.0	0	0		
B10	B09	B09	3-72-1-L	TUNNEL	35.0	0	0	DWT	Z
B10	B09	B09	4-72-1-F	FUEL OIL TANK	46.8	0	0		
B10	B09	B09	4-72-2-F	FUEL OIL TANK	91.8	0	0		
B10	B09	B09	4-72-3-F	FUEL OIL TANK	70.2	0	0		
B10	B09	B09	4-72-4-F	FUEL OIL TANK	70.2	0	0		
B10		B10	2-52-0-C	MAIN CONTROL STATION	360.0	0	0	DWT	Z
B10	B09	B09	2-72-0-W	ANTI-ROLL TANK	234.0	0	0		
D06			2-52-0-C	MAIN CONTROL STATION	64.0	0	0		
D06			2-52-0-C	MAIN CONTROL STATION	64.0	0	0		
D06			1-9-0B-L	PASSAGE	120.0	0	0		
D06			1-52-1-L	CREWS MESSROOM	69.1	0	0		
D06			1-58-2-L	CREWS SR (3)	72.8	0	0		
D06			1-62-1-A	DC LKR	17.3	0	0		
D06			1-62-3-Q	GENERAL WORKSHOP	176.4	0	0		
D06			1-63-2-L	CREWS SR (3)	102.0	0	0		
D06			1-66-2-L	T/S	38.2	0	0		
D00			1-68-1-L	STWY	33.8	0	0		
D06			1-68-3-Q	FAN ROOM	135.4	0	0		
D06			1-68-2-L	CREWS SR (3)	99.0	0	0		
			3-52-02-W	**POTABLE WATER**	**(CUI = W)**				
B09	B09	B10	3-34-0-E	MAIN GENERATOR RM	112.0	0	0		
B05		B06	3-52-01-E	PROPULSION MTR RM	48.0	0	0		
B05		B06	3-52-01-E	PROPULSION MTR RM	48.0	0	0		
B05		B05	3-58-0-W	AUXILARY POTABLE WAT	112.0	0	0		
D04			2-52-0-C	MAIN CONTROL STATION	336.0	0	0		
			3-58-0-W	**AUXILARY POTABLE WATER**	**(CUI = W)**				
B05		B06	3-52-01-E	PROPULSION MTR RM	16.0	0	0		
B05		B06	3-52-01-E	PROPULSION MTR RM	112.0	0	0		
B05		B06	3-52-01-E	PROPULSION MTR RM	16.0	0	0		
B05		B05	3-52-02-W	POTABLE WATER	112.0	0	0		
D04			2-52-0-C	MAIN CONTROL STATION	112.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			3-72-1-L	**TUNNEL**	**(CUI = LP)**				
B09	B09	B10	3-52-01-E	PROPULSION MTR RM	35.0	0	0	DWT	Z
B05		B05	4-72-1-F	FUEL OIL TANK	35.0	0	0		
B05		B05	4-72-1-F	FUEL OIL TANK	112.0	0	0		
B05		B05	4-72-1-F	FUEL OIL TANK	117.0	0	0		
B05		B05	4-72-2-F	FUEL OIL TANK	112.0	0	0		
B05		B05	4-72-2-F	FUEL OIL TANK	117.0	0	0		
B05		B05	2-72-0-W	ANTI-ROLL TANK	32.5	0	0		
B09	B09	B09	2-86-1-L	TUNNEL	32.5	0	0	DWT	Z
D04			4-72-1-F	FUEL OIL TANK	60.0	0	0		
D06			2-72-0-W	ANTI-ROLL TANK	50.0	0	0		
D06			1-75-0-Q	D.C. SHOP	30.0	0	0		
D06			(none)	(weather overhead)	60.0	0	0		
			4-86-1-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-72-1-F	FUEL OIL TANK	45.9	0	0		
B09	B09	B09	4-72-1-F	FUEL OIL TANK	33.8	0	0		
B09	B09	B09	4-80-1-F	FUEL OIL TANK	50.4	0	0		
B09	B09	B09	4-80-1-F	FUEL OIL TANK	72.8	0	0		
B05		B05	4-86-2-W	BALLAST TANK	45.0	0	0		
B05		B05	2-86-1-L	TUNNEL	104.0	0	0		
B09	B09	B09	2-94-0-Q	STEERING GEAR RM	40.0	0	0		
B09	B09	B09	3-94-1-W	AFTER PEAK BALLAST T	40.0	0	0		
B05	H03		(none)	(weather bulkhead)	95.4	0	0		
B05	H03		(none)	(weather bulkhead)	45.0	0	0		
B09	H03		(none)	(weather bulkhead)	104.0	0	0		
D04			2-86-1-L	TUNNEL	50.0	0	0		
D04			(none)	(weather overhead)	259.2	0	0		
			4-86-2-W	**BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-72-2-F	FUEL OIL TANK	45.9	0	0		
B09	B09	B09	4-72-2-F	FUEL OIL TANK	66.3	0	0		
B09	B09	B09	4-80-2-F	FUEL OIL TANK	50.4	0	0		
B09	B09	B09	4-80-2-F	FUEL OIL TANK	72.8	0	0		
B05		B05	4-86-1-W	BALLAST TANK	45.0	0	0		
B05		B05	2-86-1-L	TUNNEL	104.0	0	0		
B09	B09	B09	2-94-0-Q	STEERING GEAR RM	65.0	0	0		
B09	B09	B09	3-94-2-W	AFTER PEAK BALLAST T	40.0	0	0		
B05	H03		(none)	(weather bulkhead)	45.0	0	0		
B05	H03		(none)	(weather bulkhead)	95.4	0	0		
B09	H03		(none)	(weather bulkhead)	104.0	0	0		
D04			(none)	(weather overhead)	339.2	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft^2	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			2-6-0-E	**BOW THRUSTER ELEC MTR RM**	**(CUI = EM)**				
B09	B09	B09	4-B-0-W	FOREPEAK BALLAST TAN	202.0	0	0		
B09	B09	B09	4-12-0-F	FUEL OIL TANK	160.0	0	0		
B09	B09	B09	4-12-1-F	FUEL OIL TANK	66.0	0	0		
B09	B09	B09	4-12-2-F	FUEL OIL TANK	66.0	0	0		
B09	H03		(none)	(weather bulkhead)	127.8	0	0		
B09	H03		(none)	(weather bulkhead)	128.5	0	0		
D04			4-6-1-W	BALLAST TANK	147.6	0	0		
D04			4-6-2-W	BALLAST TANK	148.8	0	0		
D06			1-6-1-A	CHAIN LKR	32.4	0	0		
D06			1-6-2-A	CHAIN LKR	33.6	0	0		
D06			1-6-3-A	DRY PROVISIONS STRM	103.1	0	0		
D06			1-6-4-Q	SHIP STORE	84.9	0	0		
D06			1-9-0-L	PASSAGE	42.0	0	0	HL	Z
			2-24-0-L	**PASSAGE**	**(CUI = LP)**				
B10		B09	4-18-0-F	FUEL OIL TANK	20.0	0	0		
B10	B09	B06	3-34-0-E	MAIN GENERATOR RM	110.0	0	0	DWT	Z
B06		B06	2-24-1-Q	LAUNDRY RM	96.0	0	0	DJ	NC
B06		B06	2-24-1-Q	LAUNDRY RM	72.0	-30	-8		
B05		B06	2-24-1-Q	LAUNDRY RM	16.0	0	0		
B06		B06	2-24-1A-Q	LAUNDRY RM	20.0	0	0		
B05		B05	2-24-2-A	ENGR STRM	120.0	0	0		
B05		B05	2-24-2-A	ENGR STRM	70.0	-30	-8	DJ	NC
B05		B05	2-24-2-A	ENGR STRM	16.0	0	0		
B05		B06	2-24-4-Q	A/C MCHRY SPACE	48.0	0	0	DWT	Z
B06		B06	2-29-1-Q	SEWAGE MCHRY RM	36.0	0	0	DWT	Z
B05		B05	2-31-1-W	SEWAGE HOLDING TANK	96.0	0	0		
B05		B05	2-31-1-W	SEWAGE HOLDING TANK	60.0	0	0		
D04			4-24-1-T	SPEED LOG XDCR TRUNK	3.2	0	0		
D04			4-24-2-W	BALLAST TANK	33.6	0	0		
D04			4-24-3-W	BALLAST TANK	82.6	0	0		
D04			4-31-1-T	TRANSDUCER TRUNK	16.0	0	0		
D04			2-24-1A-Q	LAUNDRY RM	12.8	0	0		
D04			1-9-0A-L	PASSAGE	66.1	0	0		
D04			1-22-1-L	STWY	28.8	0	0	HO	O
D04			2-22-1-L	STWY	12.8	0	0		
D04			1-30-1-L	HOSPITAL	15.8	0	0		
D04			1-30-2-L	CREWS SR (3)	9.6	0	0		
D04			1-32-1-L	T/S	15.0	0	0		
			2-24-1-Q	**LAUNDRY RM**	**(CUI = QL)**				
B10	B09	B09	4-12-1-F	FUEL OIL TANK	120.0	0	0		
B10	B09	B09	4-18-0-F	FUEL OIL TANK	40.0	0	0		
B06		B06	2-24-0-L	PASSAGE	96.0	0	0	DJ	NC
B06		B06	2-24-0-L	PASSAGE	72.0	-30	-8		
B06		B05	2-24-0-L	PASSAGE	16.0	0	0		
B00		B00	2-24-1A-Q	LAUNDRY RM	16.0	0	0		
B06		B06	2-29-1-Q	SEWAGE MCHRY RM	74.0	0	0		
B10	H03		(none)	(weather bulkhead)	104.5	0	0		
D04			4-24-1-T	SPEED LOG XDCR TRUNK	16.0	0	0		
D04			4-24-3-W	BALLAST TANK	154.7	0	0		
D06			1-9-0A-L	PASSAGE	2.1	0	0		
D06			1-22-3-L	EXERCISE RM	164.2	0	0		
D06			1-30-1-L	HOSPITAL	2.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			2-24-1A-Q	**LAUNDRY RM**	**(CUI = QL)**				
B10	B09	B09	4-18-0-F	FUEL OIL TANK	20.0	0	0		
B06		B06	2-24-0-L	PASSAGE	20.0	0	0		
B00		B00	2-24-1-Q	LAUNDRY RM	16.0	0	0		
B06		B06	2-24-2-A	ENGR STRM	16.0	0	0		
D04			4-24-1-T	SPEED LOG XDCR TRUNK	12.8	0	0		
D04			2-24-0-L	PASSAGE	12.8	0	0		
			2-24-2-A	**ENGR STRM**	**(CUI = AS)**				
B10	B09	B09	4-18-0-F	FUEL OIL TANK	70.0	0	0		
B05		B05	2-24-0-L	PASSAGE	120.0	0	0		
B05		B05	2-24-0-L	PASSAGE	70.0	-30	-8	DJ	NC
B05		B05	2-24-0-L	PASSAGE	16.0	0	0		
B06		B06	2-24-1A-Q	LAUNDRY RM	16.0	0	0		
B05		B06	2-24-4-Q	A/C MCHRY SPACE	152.0	0	0		
D04			4-24-2-W	BALLAST TANK	106.4	0	0		
D04			1-9-0A-L	PASSAGE	76.0	0	0		
D04			1-24-2-L	CREWS SR (3)	13.2	0	0		
D04			1-28-2-A	CBR LKR	13.2	0	0		
D04			1-30-2-L	CREWS SR (3)	4.0	0	0		
			2-24-4-Q	**A/C MCHRY SPACE**	**(CUI = QA)**				
B10	B09	B09	4-12-2-F	FUEL OIL TANK	118.0	0	0		
B10		B09	4-18-0-F	FUEL OIL TANK	10.0	0	0		
B10	B09	B09	3-34-0-E	MAIN GENERATOR RM	110.0	0	0		
B10	B09	B09	4-34-2-V	VOID	34.0	0	0		
B06		B05	2-24-0-L	PASSAGE	48.0	0	0	DWT	Z
B06		B05	2-24-2-A	ENGR STRM	152.0	0	0		
B10	H03		(none)	(weather bulkhead)	200.6	0	0		
D04			4-24-2-W	BALLAST TANK	20.0	0	0		
D04			4-24-4-W	BALLAST TANK	252.0	0	0		
D06			1-24-2-L	CREWS SR (3)	111.6	0	0		
D06			1-28-2-A	CBR LKR	4.0	0	0		
D06			1-28-4-L	T/S	35.5	0	0		
D06			1-30-2-L	CREWS SR (3)	120.9	0	0		
			2-29-1-Q	**SEWAGE MCHRY RM**	**(CUI = QA)**				
B09	B09	B09	3-34-0-E	MAIN GENERATOR RM	44.0	0	0		
B10	B09	B09	4-34-1-V	VOID	36.0	0	0		
B06		B06	2-24-0-L	PASSAGE	36.0	0	0	DWT	Z
B06		B06	2-24-1-Q	LAUNDRY RM	74.0	0	0		
B06		B05	2-31-1-W	SEWAGE HOLDING TANK	60.0	0	0		
B10	H03		(none)	(weather bulkhead)	96.2	0	0		
D04			4-24-3-W	BALLAST TANK	73.1	0	0		
D06			1-30-1-L	HOSPITAL	73.0	0	0		
			2-31-1-W	**SEWAGE HOLDING TANK**	**(CUI = W)**				
B05	B09	B06	3-34-0-E	MAIN GENERATOR RM	96.0	0	0		
B05		B05	2-24-0-L	PASSAGE	96.0	0	0		
B05		B05	2-24-0-L	PASSAGE	60.0	0	0		
B05		B06	2-29-1-Q	SEWAGE MCHRY RM	60.0	0	0		
D04			4-24-3-W	BALLAST TANK	57.6	0	0		
D04			1-9-0A-L	PASSAGE	5.2	0	0		
D04			1-30-1-L	HOSPITAL	34.4	0	0		
D04			1-32-1-L	T/S	18.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft^2	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			2-52-0-C	**MAIN CONTROL STATION**	**(CUI = C)**				
B10	B09	B10	3-34-0-E	MAIN GENERATOR RM	360.0	0	0	DWT	Z
B10		B10	3-52-01-E	PROPULSION MTR RM	360.0	0	0	DWT	Z
B06		B05	4-52-3-F	FO SERV TANK	160.0	0	0		
B06		B05	4-52-4-F	FO SERV TANK	160.0	0	0		
D06			3-52-01-E	PROPULSION MTR RM	64.0	0	0		
D06			3-52-01-E	PROPULSION MTR RM	64.0	0	0		
D04			3-52-02-W	POTABLE WATER	336.0	0	0		
D04			3-58-0-W	AUXILARY POTABLE WAT	112.0	0	0		
D06			1-9-0B-L	PASSAGE	80.0	0	0		
D04			1-45-2-L	CREWS SR (6)	41.6	0	0		
D06			1-52-1-L	CREWS MESSROOM	288.0	0	0		
D06			1-54-2-L	CREWS SR (3)	101.6	0	0		
D04			1-57-2-L	T/S	36.9	0	0		
D04			1-58-2-L	CREWS SR (3)	27.9	0	0		
			2-72-0-W	**ANTI-ROLL TANK**	**(CUI = W)**				
B09	B09	B10	3-52-01-E	PROPULSION MTR RM	234.0	0	0		
B09	B09	B09	4-66-1-F	OILY WASTE TK	23.4	0	0		
B09	B09	B09	4-66-2-F	OILY WASTE TANK	22.1	0	0		
B05		B05	3-72-1-L	TUNNEL	32.5	0	0		
B05		B05	4-72-1-F	FUEL OIL TANK	33.8	0	0		
B05		B05	4-72-2-F	FUEL OIL TANK	66.3	0	0		
B05		B05	4-72-3-F	FUEL OIL TANK	74.1	0	0		
B05		B05	4-72-4-F	FUEL OIL TANK	72.8	0	0		
B09	H03		(none)	(weather bulkhead)	65.0	0	0		
B09	H03		(none)	(weather bulkhead)	65.0	0	0		
D06			3-72-1-L	TUNNEL	50.0	0	0		
D04			4-72-1-F	FUEL OIL TANK	52.0	0	0		
D04			4-72-2-F	FUEL OIL TANK	102.0	0	0		
D04			4-72-3-F	FUEL OIL TANK	114.0	0	0		
D04			4-72-4-F	FUEL OIL TANK	112.0	0	0		
D04			1-72-2-L	VESTIBULE	29.0	0	0		
D04			1-75-0-Q	D.C. SHOP	99.1	0	0		
D04			(none)	(weather overhead)	301.9	0	0		
			2-86-1-L	**TUNNEL**	**(CUI = LP)**				
B09	B09	B09	3-72-1-L	TUNNEL	32.5	0	0	DWT	Z
B05		B05	4-86-1-W	BALLAST TANK	104.0	0	0		
B05		B05	4-86-2-W	BALLAST TANK	104.0	0	0		
B09	B09	B09	2-94-0-Q	STEERING GEAR RM	25.0	0	0	DWT	Z
D04			4-86-1-W	BALLAST TANK	50.0	0	0		
D06			(none)	(weather overhead)	80.0	0	0		
			2-94-0-Q	**STEERING GEAR RM**	**(CUI = QA)**				
B09	B09	B09	4-86-1-W	BALLAST TANK	40.0	0	0		
B09	B09	B09	4-86-2-W	BALLAST TANK	65.0	0	0		
B09	B09	B09	2-86-1-L	TUNNEL	25.0	0	0	DWT	Z
B05		B05	3-94-1-W	AFTER PEAK BALLAST T	65.0	0	0		
B05		B05	3-94-1-W	AFTER PEAK BALLAST T	60.0	0	0		
B05		B05	3-94-2-W	AFTER PEAK BALLAST T	60.0	0	0		
B05		B05	3-94-2-W	AFTER PEAK BALLAST T	65.0	0	0		
D06			(none)	(weather overhead)	312.0	0	0	HS	Y

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			3-94-1-W	**AFTER PEAK BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-86-1-W	BALLAST TANK	40.0	0	0		
B05		B05	2-94-0-Q	STEERING GEAR RM	65.0	0	0		
B05		B05	2-94-0-Q	STEERING GEAR RM	60.0	0	0		
B05		B05	3-94-2-W	AFTER PEAK BALLAST T	30.0	0	0		
B09	H03		(none)	(weather bulkhead)	75.0	0	0		
B09	H03		(none)	(weather bulkhead)	15.7	0	0		
B09	H03		(none)	(weather bulkhead)	19.4	0	0		
B09	H03		(none)	(weather bulkhead)	67.2	0	0		
D06			(none)	(weather overhead)	202.1	0	0		
			3-94-2-W	**AFTER PEAK BALLAST TANK**	**(CUI = W)**				
B09	B09	B09	4-86-2-W	BALLAST TANK	40.0	0	0		
B05		B05	2-94-0-Q	STEERING GEAR RM	60.0	0	0		
B05		B05	2-94-0-Q	STEERING GEAR RM	65.0	0	0		
B05		B05	3-94-1-W	AFTER PEAK BALLAST T	30.0	0	0		
B09	H03		(none)	(weather bulkhead)	67.1	0	0		
B09	H03		(none)	(weather bulkhead)	18.9	0	0		
B09	H03		(none)	(weather bulkhead)	18.4	0	0		
B09	H03		(none)	(weather bulkhead)	74.0	0	0		
D04			(none)	(weather overhead)	204.6	0	0		
			2-22-1-L	**STWY**	**(CUI = LP)**				
B05		B05	1-9-0A-L	PASSAGE	32.4	0	0	DWT	Z
B06		B06	1-18-1-A	THAW ROOM	18.0	0	0		
B05		B05	1-22-1-L	STWY	18.0	0	0		
B05		BOP	1-22-3-L	EXERCISE RM	32.4	0	0		
D04			4-18-0-F	FUEL OIL TANK	16.0	0	0		
D04			2-24-0-L	PASSAGE	12.8	0	0		
D04			1-22-1-L	STWY	28.8	0	0		
			1-D-0-A	**STEWARD STOREROOM**	**(CUI = AS)**				
B09		B09	1-6-1-A	CHAIN LKR	36.5	0	0		
B09		B09	1-6-1-A	CHAIN LKR	10.8	0	0		
B09		B09	1-6-2-A	CHAIN LKR	37.8	0	0		
B09		B09	1-6-2-A	CHAIN LKR	11.2	0	0		
B09		B09	1-6-3-A	DRY PROVISIONS STRM	32.4	0	0		
B09		B09	1-6-3-A	DRY PROVISIONS STRM	9.6	0	0		
B09		B09	1-6-4-Q	SHIP STORE	31.1	0	0		
B09		B09	1-6-4-Q	SHIP STORE	9.2	0	0		
B05	B06		(none)	(weather bulkhead)	128.1	0	0		
B05	B06		(none)	(weather bulkhead)	128.1	0	0		
B05	B06		(none)	(weather bulkhead)	38.0	0	0		
B05	B06		(none)	(weather bulkhead)	38.0	0	0		
D04			4-B-0-W	FOREPEAK BALLAST TAN	121.2	0	0		
D06			01-G-0-A	BOSUN STORES	35.9	0	0		
D06			01-1-2-A	STRM NO 2	50.1	0	0		
D06			01-2-0-L	PASSAGE	35.2	0	0		
D06			01-2-1-A	STRM NO 1	42.0	0	0	HO	O

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-6-1-A	**CHAIN LKR**	**(CUI = AG)**				
B09		B09	1-D-0-A	STEWARD STOREROOM	36.5	0	0		
B09		B09	1-D-0-A	STEWARD STOREROOM	10.8	0	0		
B09		B09	1-6-2-A	CHAIN LKR	40.5	0	0		
B09		B09	1-6-2-A	CHAIN LKR	12.0	0	0		
B09		B10	1-6-3-A	DRY PROVISIONS STRM	23.0	0	0		
B09		B10	1-6-3-A	DRY PROVISIONS STRM	40.5	0	0		
B09		B10	1-6-3-A	DRY PROVISIONS STRM	6.8	0	0		
B09		B10	1-6-3-A	DRY PROVISIONS STRM	12.0	0	0		
B09		B09	1-9-0-L	PASSAGE	13.5	0	0		
B10		BOP	1-9-0-L	PASSAGE	4.0	0	0		
D06			2-6-0-E	BOW THRUSTER ELEC MT	32.4	0	0		
D06			01-6-0-Q	EMER SWBD & GEN RM	32.4	0	0		
			1-6-2-A	**CHAIN LKR**	**(CUI = AG)**				
B09		B09	1-D-0-A	STEWARD STOREROOM	37.8	0	0		
B09		B09	1-D-0-A	STEWARD STOREROOM	11.2	0	0		
B09		B09	1-6-1-A	CHAIN LKR	40.5	0	0		
B09		B09	1-6-1-A	CHAIN LKR	12.0	0	0		
B09		B09	1-6-4-Q	SHIP STORE	40.5	0	0		
B09		B09	1-6-4-Q	SHIP STORE	4.1	0	0		
B10		BOP	1-6-4-Q	SHIP STORE	12.0	0	0		
B10		BOP	1-6-4-Q	SHIP STORE	1.2	0	0		
B09		B09	1-9-0-L	PASSAGE	33.8	0	0		
B10		BOP	1-9-0-L	PASSAGE	10.0	0	0		
D06			2-6-0-E	BOW THRUSTER ELEC MT	33.6	0	0		
D06			01-6-0-Q	EMER SWBD & GEN RM	33.6	0	0		
			1-6-3-A	**DRY PROVISIONS STRM**	**(CUI = AS)**				
B09		B09	1-D-0-A	STEWARD STOREROOM	32.4	0	0		
B09		B09	1-D-0-A	STEWARD STOREROOM	9.6	0	0		
B10		B09	1-6-1-A	CHAIN LKR	23.0	0	0		
B10		B09	1-6-1-A	CHAIN LKR	40.5	0	0		
B10		B09	1-6-1-A	CHAIN LKR	6.8	0	0		
B10		B09	1-6-1-A	CHAIN LKR	12.0	0	0		
BOP		BOP	1-9-0-L	PASSAGE	67.5	-99	-56	DJ	NC
BOP		BOP	1-9-0-L	PASSAGE	20.0	-15	-15		
B06		B06	1-14-1-A	FREEZE ROOM	94.5	0	0		
B05		B05	1A-14-1-Q	MAIN DECK UTILITY SP	28.0	0	0		
B05	B06		(none)	(weather bulkhead)	114.9	0	0		
B05	B06		(none)	(weather bulkhead)	34.0	0	0		
D04			4-12-0-F	FUEL OIL TANK	24.0	0	0		
D04			4-12-1-F	FUEL OIL TANK	28.2	0	0		
D06			2-6-0-E	BOW THRUSTER ELEC MT	103.1	0	0		
D06			01-6-0-Q	EMER SWBD & GEN RM	114.8	0	0		
D06			01-10-0-L	PASSAGE	8.0	0	0		
D06			(none)	(weather overhead)	34.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-6-4-Q	**SHIP STORE**	**(CUI = QO)**				
B09		B09	1-D-0-A	STEWARD STOREROOM	31.1	0	0		
B09		B09	1-D-0-A	STEWARD STOREROOM	9.2	0	0		
B09		B09	1-6-2-A	CHAIN LKR	40.5	0	0		
B09		B09	1-6-2-A	CHAIN LKR	4.1	0	0		
BOP		B10	1-6-2-A	CHAIN LKR	12.0	0	0		
BOP		B10	1-6-2-A	CHAIN LKR	1.2	0	0		
BOP		BOP	1-9-0-L	PASSAGE	67.5	-99	-56	2 DJ	NC
BOP		BOP	1-9-0-L	PASSAGE	20.0	-5	-5		
B06		B06	1-9-0A-L	PASSAGE	20.3	0	0		
B06		BOP	1-14-2-L	RECREATION ROOM	54.0	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	22.0	0	0		
B05	B06		(none)	(weather bulkhead)	114.9	0	0		
B05	B06		(none)	(weather bulkhead)	34.0	0	0		
D04			4-12-0-F	FUEL OIL TANK	12.0	0	0		
D04			4-12-2-F	FUEL OIL TANK	28.1	0	0		
D06			2-6-0-E	BOW THRUSTER ELEC MT	84.9	0	0		
D06			01-6-0-Q	EMER SWBD & GEN RM	83.0	0	0		
D06			01-10-0-L	PASSAGE	4.2	0	0		
D06			(none)	(weather overhead)	38.8	0	0		
			1-9-0-L	**PASSAGE**	**(CUI = LP)**				
B09		B09	1-6-1-A	CHAIN LKR	13.5	0	0		
BOP		B10	1-6-1-A	CHAIN LKR	4.0	0	0		
B09		B09	1-6-2-A	CHAIN LKR	33.8	0	0		
BOP		B10	1-6-2-A	CHAIN LKR	10.0	0	0		
BOP		BOP	1-6-3-A	DRY PROVISIONS STRM	67.5	-99	-56	DJ	NC
BOP		BOP	1-6-3-A	DRY PROVISIONS STRM	20.0	-15	-15		
BOP		BOP	1-6-4-Q	SHIP STORE	67.5	-99	-56	2 DJ	NC
BOP		BOP	1-6-4-Q	SHIP STORE	20.0	-5	-5		
B06		B06	1-9-0A-L	PASSAGE	33.8	0	0	DO	O
B06		B06	1-14-1-A	FREEZE ROOM	13.5	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	10.0	-5	-5		
B05		B05	1A-14-1-Q	MAIN DECK UTILITY SP	4.0	0	0		
D04			4-12-0-F	FUEL OIL TANK	28.0	0	0		
D06			2-6-0-E	BOW THRUSTER ELEC MT	42.0	0	0	HL	Z
D06			01-6-0-Q	EMER SWBD & GEN RM	21.9	0	0		
D06			01-10-0-L	PASSAGE	48.1	0	0	HL	Z

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-9-0A-L	**PASSAGE**	**(CUI = LP)**				
B06		B06	1-6-4-Q	SHIP STORE	20.3	0	0		
B06		B06	1-9-0-L	PASSAGE	33.8	0	0	DO	O
B05		B05	1-9-0B-L	PASSAGE	33.8	0	0	DJ	NO
B06		B06	1-14-1-A	FREEZE ROOM	55.4	0	0		
BOP		BOP	1-14-2-L	RECREATION ROOM	44.6	0	0		
BOP		BOP	1-14-2-L	RECREATION ROOM	20.3	0	0		
BOP		BOP	1-14-2-L	RECREATION ROOM	90.5	-99	-56	DJ	NC
B06		B06	1-18-1-A	THAW ROOM	52.7	0	0	DWT	Z
B05		B05	1-22-1-L	STWY	27.0	0	0		
B05		B05	1-22-1-L	STWY	48.6	0	0	DWT	Z
B05		B05	1-22-1-L	STWY	16.2	0	0		
BOP		BOP	1-22-3-L	EXERCISE RM	35.1	-99	-56	DJ	NC
B05		B05	2-22-1-L	STWY	32.4	0	0	DWT	Z
BOP		BOP	1-24-2-L	CREWS SR (3)	44.6	-99	-56	DJ	NC
BOP		BOP	1-28-2-A	CBR LKR	44.6	-30	-8	DJ	NC
BOP		BOP	1-30-1-L	HOSPITAL	10.8	0	0		
BOP		BOP	1-30-1-L	HOSPITAL	33.8	-99	-56	2 DJ	NC
BOP		BOP	1-30-2-L	CREWS SR (3)	45.9	-99	-56	DJ	NC
BOP		BOF	1-32-1-L	T/S	44.6	0	0		
BOP		BOF	1-32-1-L	T/S	33.8	0	0		
BOP		BOP	1-34-1-L	WARDROOM	6.8	0	0		
D04			4-12-0-F	FUEL OIL TANK	60.8	0	0		
D04			4-18-0-F	FUEL OIL TANK	59.0	0	0		
D04			2-24-0-L	PASSAGE	66.1	0	0		
D06			2-24-1-Q	LAUNDRY RM	2.1	0	0		
D04			2-24-2-A	ENGR STRM	76.0	0	0		
D04			2-31-1-W	SEWAGE HOLDING TANK	5.2	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	269.2	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-9-0B-L	**PASSAGE**	**(CUI = LP)**				
B05		B05	1-9-0A-L	PASSAGE	33.8	0	0	DJ	NO
B05		BOP	1-34-1-L	WARDROOM	121.5	-99	-56	DJ	NC
B05		B06	1-34-2-Q	FAN ROOM	81.0	0	0	DWT	X
B05		B06	1-34-2-Q	FAN ROOM	31.1	0	0		
B05		B05	1-40-2-A	CG LKR	50.0	-30	-8	DJ	NC
B05		B05	1-42-1-Q	GALLEY	33.8	-99	-56	DJ	NC
B05		B05	1-44-2-Q	SCULLERY	31.1	0	0		
B05		B05	1-44-2-Q	SCULLERY	47.3	0	0	DWT	Z
BOP		BOP	1-45-2-L	CREWS SR (6)	40.5	-99	-56	DJ	NC
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	87.8	0	0	DWT	Z
BOP		BOF	1-48-2-L	T/S	45.9	0	0		
B05		BOP	1-52-1-L	CREWS MESSROOM	129.6	-99	-56	DJ	NC
BOP		BOP	1-54-2-L	CREWS SR (3)	40.5	-99	-56	DJ	NC
BOP		BOF	1-57-2-L	T/S	44.6	0	0		
BOP		BOP	1-58-2-L	CREWS SR (3)	39.2	-99	-56	DJ	NC
B05		B05	1-62-1-A	DC LKR	32.4	-30	-8	DJ	NC
B06		B05	1-62-3-Q	GENERAL WORKSHOP	44.6	-30	-8	DJ	NC
BOP		BOP	1-63-2-L	CREWS SR (3)	39.2	-99	-56	DJ	NC
BOP		BOF	1-66-2-L	T/S	45.9	0	0		
B05		B05	1-68-1-L	STWY	63.5	0	0	DWT	Z
BOP		BOP	1-68-2-L	CREWS SR (3)	39.2	-99	-56	DJ	NC
B05		B05	1-72-2-L	VESTIBULE	33.8	0	0	DWT	Z
D06			3-34-0-E	MAIN GENERATOR RM	214.0	0	0		
D06			3-52-01-E	PROPULSION MTR RM	120.0	0	0		
D06			2-52-0-C	MAIN CONTROL STATION	80.0	0	0		
DOC			1A-34-2-Q	MAIN DECK UTILITY SP	414.0	0	0		
			1-14-1-A	**FREEZE ROOM**	**(CUI = AR)**				
B06		B06	1-6-3-A	DRY PROVISIONS STRM	94.5	0	0		
B06		B06	1-9-0-L	PASSAGE	13.5	0	0		
B06		B06	1-9-0A-L	PASSAGE	55.4	0	0		
B06		B06	1-18-1-A	THAW ROOM	31.1	0	0	DWT	Y
B06		B06	1-18-3-A	CHILL ROOM	90.5	0	0		
B06	B06		(none)	(weather bulkhead)	57.0	0	0		
D04			4-12-0-F	FUEL OIL TANK	65.6	0	0		
D04			4-12-1-F	FUEL OIL TANK	69.1	0	0		
D03			1A-14-1-Q	MAIN DECK UTILITY SP	139.4	0	0		
			1-14-2-L	**RECREATION ROOM**	**(CUI = LL)**				
BOP		B06	1-6-4-Q	SHIP STORE	54.0	0	0		
BOP		BOP	1-9-0A-L	PASSAGE	44.6	0	0		
BOP		BOP	1-9-0A-L	PASSAGE	20.3	0	0		
BOP		BOP	1-9-0A-L	PASSAGE	90.5	-99	-56	DJ	NC
BOP		BOP	1-24-2-L	CREWS SR (3)	99.9	0	0		
BOP	B06		(none)	(weather bulkhead)	137.4	0	0		
D04			4-12-0-F	FUEL OIL TANK	4.8	0	0		
D04			4-12-2-F	FUEL OIL TANK	192.7	0	0		
D04			4-18-0-F	FUEL OIL TANK	35.4	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	238.2	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-18-1-A	**THAW ROOM**	**(CUI = AR)**				
B06		B06	1-9-0A-L	PASSAGE	52.7	0	0	DWT	Z
B06		B06	1-14-1-A	FREEZE ROOM	31.1	0	0	DWT	Y
B06		B06	1-18-3-A	CHILL ROOM	52.7	0	0	DWT	Y
B05		B05	1-22-1-L	STWY	9.0	0	0		
B06		BOP	1-22-3-L	EXERCISE RM	4.1	0	0		
B06		B06	2-22-1-L	STWY	18.0	0	0		
D04			4-18-0-F	FUEL OIL TANK	35.9	0	0		
D03			1A-14-1-Q	MAIN DECK UTILITY SP	35.9	0	0		
			1-18-3-A	**CHILL ROOM**	**(CUI = AR)**				
B06		B06	1-14-1-A	FREEZE ROOM	90.5	0	0		
B06		B06	1-18-1-A	THAW ROOM	52.7	0	0	DWT	Y
B06		BOP	1-22-3-L	EXERCISE RM	99.9	0	0		
B06	B06		(none)	(weather bulkhead)	53.5	0	0		
D04			4-12-1-F	FUEL OIL TANK	79.7	0	0		
D04			4-18-0-F	FUEL OIL TANK	26.5	0	0		
D03			1A-14-1-Q	MAIN DECK UTILITY SP	110.0	0	0		
			1-22-1-L	**STWY**	**(CUI = LP)**				
B05		B05	1-9-0A-L	PASSAGE	27.0	0	0		
B05		B05	1-9-0A-L	PASSAGE	48.6	0	0	DWT	Z
B05		B05	1-9-0A-L	PASSAGE	16.2	0	0		
B05		B05	1-18-1-A	THAW ROOM	9.0	0	0		
B05		BOP	1-22-3-L	EXERCISE RM	45.9	0	0		
B05		BOP	1-22-3-L	EXERCISE RM	16.2	0	0		
B05		B05	2-22-1-L	STWY	18.0	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	28.8	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	8.0	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	28.8	0	0		
B05		B05	1A-14-1-Q	MAIN DECK UTILITY SP	8.0	0	0		
B05		B05	01-10-0A-L	PASSAGE	30.6	0	0	DWT	Z
B05		BOP	01-19-1-L	CREW SR (2)	17.0	0	0		
B05		BOP	01-19-1-L	CREW SR (2)	13.6	0	0		
B05		B05	01-22-1-L	STAIRWAY	17.0	0	0		
B05		BOP	01-24-1-L	CREW SR (2)	17.0	0	0		
D04			2-24-0-L	PASSAGE	28.8	0	0	HO	O
D04			2-22-1-L	STWY	28.8	0	0		
D04			01-22-1-L	STAIRWAY	28.8	0	0		
D04			01-22-1-L	STAIRWAY	28.8	0	0		
			1-22-3-L	**EXERCISE RM**	**(CUI = LL)**				
BOP		BOP	1-9-0A-L	PASSAGE	35.1	-99	-56	DJ	NC
BOP		B06	1-18-1-A	THAW ROOM	4.1	0	0		
BOP		B06	1-18-3-A	CHILL ROOM	99.9	0	0		
BOP		B05	1-22-1-L	STWY	45.9	0	0		
BOP		B05	1-22-1-L	STWY	16.2	0	0		
BOP		B05	2-22-1-L	STWY	32.4	0	0		
BOP		BOP	1-30-1-L	HOSPITAL	79.7	0	0		
BOP	B06		(none)	(weather bulkhead)	95.1	0	0		
D04			4-12-1-F	FUEL OIL TANK	46.1	0	0		
D04			4-18-0-F	FUEL OIL TANK	16.0	0	0		
D06			2-24-1-Q	LAUNDRY RM	164.2	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	226.8	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-24-2-L	**CREWS SR (3)**	**(CUI = L5)**				
BOP		BOP	1-9-0A-L	PASSAGE	44.6	-99	-56	DJ	NC
BOP		BOP	1-14-2-L	RECREATION ROOM	99.9	0	0		
BOP		BOP	1-28-2-A	CBR LKR	17.6	0	0		
BOP		BOF	1-28-4-L	T/S	16.5	-99	-56	DJ	NC
BOP		BOF	1-28-4-L	T/S	25.7	0	0		
BOP		BOF	1-28-4-L	T/S	13.5	0	0		
BOP		BOP	1-30-2-L	CREWS SR (3)	51.3	0	0		
BOP	B06		(none)	(weather bulkhead)	68.0	0	0		
D04			2-24-2-A	ENGR STRM	13.2	0	0		
D06			2-24-4-Q	A/C MCHRY SPACE	111.6	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	126.8	0	0		
			1-28-2-A	**CBR LKR**	**(CUI = AG)**				
BOP		BOP	1-9-0A-L	PASSAGE	44.6	-30	-8	DJ	NC
BOP		BOP	1-24-2-L	CREWS SR (3)	17.6	0	0		
BOP		BOF	1-28-4-L	T/S	44.6	0	0		
BOP		BOP	1-30-2-L	CREWS SR (3)	17.6	0	0		
D04			2-24-2-A	ENGR STRM	13.2	0	0		
D06			2-24-4-Q	A/C MCHRY SPACE	4.0	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	17.2	0	0		
			1-28-4-L	**T/S**	**(CUI = LW)**				
BOF		BOP	1-24-2-L	CREWS SR (3)	16.5	-99	-56	DJ	NC
BOF		BOP	1-24-2-L	CREWS SR (3)	25.7	0	0		
BOF		BOP	1-24-2-L	CREWS SR (3)	13.5	0	0		
BOF		BOP	1-28-2-A	CBR LKR	44.6	0	0		
BOF		BOP	1-30-2-L	CREWS SR (3)	12.2	0	0		
BOF		BOP	1-30-2-L	CREWS SR (3)	16.5	-99	-56	DJ	NC
BOF		BOP	1-30-2-L	CREWS SR (3)	25.7	0	0		
D06			2-24-4-Q	A/C MCHRY SPACE	35.5	0	0		
DOF			1A-14-0-Q	MAIN DECK UTILITY SP	35.5	0	0		
			1-30-1-L	**HOSPITAL**	**(CUI = LM)**				
BOP		BOP	1-9-0A-L	PASSAGE	10.8	0	0		
BOP		BOP	1-9-0A-L	PASSAGE	33.8	-99	-56	2 DJ	NC
BOP		BOP	1-22-3-L	EXERCISE RM	79.7	0	0		
BOP		BOF	1-32-1-L	T/S	33.8	-99	-56	DJ	NC
BOP	B05	BOP	1-34-1-L	WARDROOM	93.2	0	0		
BOP	B06		(none)	(weather bulkhead)	67.6	0	0		
D04			2-24-0-L	PASSAGE	15.8	0	0		
D06			2-24-1-Q	LAUNDRY RM	2.4	0	0		
D06			2-29-1-Q	SEWAGE MCHRY RM	73.0	0	0		
D04			2-31-1-W	SEWAGE HOLDING TANK	34.4	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	128.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-30-2-L	**CREWS SR (3)**	**(CUI = L5)**				
BOP		BOP	1-9-0A-L	PASSAGE	45.9	-99	-56	DJ	NC
BOP		BOP	1-24-2-L	CREWS SR (3)	51.3	0	0		
BOP		BOP	1-28-2-A	CBR LKR	17.6	0	0		
BOP		BOF	1-28-4-L	T/S	12.2	0	0		
BOP		BOF	1-28-4-L	T/S	16.5	-99	-56	DJ	NC
BOP		BOF	1-28-4-L	T/S	25.7	0	0		
BOP		B06	1-34-2-Q	FAN ROOM	112.1	0	0		
BOP	B06		(none)	(weather bulkhead)	67.6	0	0		
D04			2-24-0-L	PASSAGE	9.6	0	0		
D04			2-24-2-A	ENGR STRM	4.0	0	0		
D06			2-24-4-Q	A/C MCHRY SPACE	120.9	0	0		
DOC			1A-14-0-Q	MAIN DECK UTILITY SP	137.5	0	0		
			1-32-1-L	**T/S**	**(CUI = LW)**				
BOF		BOP	1-9-0A-L	PASSAGE	44.6	0	0		
BOF		BOP	1-9-0A-L	PASSAGE	33.8	0	0		
BOF		BOP	1-30-1-L	HOSPITAL	33.8	-99	-56	DJ	NC
BOF	B05	BOP	1-34-1-L	WARDROOM	44.6	0	0		
D04			2-24-0-L	PASSAGE	15.0	0	0		
D04			2-31-1-W	SEWAGE HOLDING TANK	18.0	0	0		
DOF			1A-14-0-Q	MAIN DECK UTILITY SP	33.0	0	0		
			1-34-1-L	**WARDROOM**	**(CUI = LL)**				
BOP		BOP	1-9-0A-L	PASSAGE	6.8	0	0		
BOP		B05	1-9-0B-L	PASSAGE	121.5	-99	-56	DJ	NC
BOP	B05	BOP	1-30-1-L	HOSPITAL	93.2	0	0		
BOP	B05	BOF	1-32-1-L	T/S	44.6	0	0		
BOP		B06	1-40-1-T	UPTAKE	37.8	0	0		
BOP		B06	1-40-1-T	UPTAKE	36.5	0	0		
BOP		B05	1-40-3-A	HALON CYLINDER STWG	21.6	-30	-8	DJ	NC
BOP		B05	1-42-1-Q	GALLEY	36.5	0	0		
BOP		B05	1-42-1-Q	GALLEY	13.5	0	0		
BOP		B05	1-42-1-Q	GALLEY	21.6	-30	-8	DJ	NC
BOP		B05	1-42-1-Q	GALLEY	9.5	0	0		
BOP		B05	1-42-1-Q	GALLEY	27.0	-30	-8	DJ	NC
BOP	B06		(none)	(weather bulkhead)	81.0	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	282.8	0	0		
D04			4-34-1-V	VOID	40.8	0	0		
DOC			1A-34-1-Q	MAIN DECK UTILITY SP	323.6	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-34-2-Q	**FAN ROOM**	**(CUI = QF)**				
B06		B05	1-9-0B-L	PASSAGE	81.0	0	0	DWT	X
B06		B05	1-9-0B-L	PASSAGE	31.1	0	0		
B06		BOP	1-30-2-L	CREWS SR (3)	112.1	0	0		
B06		B05	1-40-2-A	CG LKR	20.3	0	0		
B06		B06	1-40-4-T	UPTAKE	37.8	0	0		
B06		B06	1-40-4-T	UPTAKE	11.2	0	0		
B06		B05	1-40-6-A	BAGGAGE STRM	23.0	0	0	DJ	NC
B06		B05	1-40-6-A	BAGGAGE STRM	6.8	0	0		
B06		B05	1A-14-0-Q	MAIN DECK UTILITY SP	33.2	0	0		
B06		B05	1A-34-2-Q	MAIN DECK UTILITY SP	24.0	0	0		
B06		B05	1A-34-2-Q	MAIN DECK UTILITY SP	15.2	0	0		
B06	B06		(none)	(weather bulkhead)	81.0	0	0		
B05	B06		(none)	(weather bulkhead)	24.0	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	156.0	0	0		
D04			4-34-2-V	VOID	40.8	0	0		
D06			01-34-2-L	CREW SR (3)	145.3	0	0		
D00			01-34-2A-T	VENT TRUNK	9.6	0	0		
D06			(none)	(weather overhead)	43.2	0	0		
			1-40-1-T	**UPTAKE**	**(CUI = TU)**				
B06		BOP	1-34-1-L	WARDROOM	37.8	0	0		
B06		BOP	1-34-1-L	WARDROOM	36.5	0	0		
B06		B05	1-40-3-A	HALON CYLINDER STWG	67.5	0	0		
B06		B05	1-40-3-A	HALON CYLINDER STWG	20.0	0	0		
B06		B05	1-42-1-Q	GALLEY	31.1	0	0		
B06		B05	1-42-1-Q	GALLEY	37.8	0	0		
B06		B05	1A-34-1-Q	MAIN DECK UTILITY SP	11.2	0	0		
B06		B05	1A-34-1-Q	MAIN DECK UTILITY SP	10.8	0	0		
B06		B06	1A-42-1-Q	MAIN DECK UTILITY SP	9.2	0	0		
B06		B06	1A-42-1-Q	MAIN DECK UTILITY SP	11.2	0	0		
B06		BOP	01-10-0B-L	PASSAGE	22.1	0	0		
B06		BOP	01-10-0B-L	PASSAGE	16.9	0	0		
B06		BOP	01-34-3-L	CREW SR (3)	36.4	0	0		
B06		BOP	01-40-1-A	SPONSOR STRM	49.4	0	0		
B06		B05	01A-34-1-Q	FCSLE DECK UTILITY S	11.2	0	0		
B06		B06	01A-34-1-Q	FCSLE DECK UTILITY S	6.8	0	0		
B06		B05	01A-34-1-Q	FCSLE DECK UTILITY S	20.4	0	0		
B06		BOP	02-35-1-L	OPS. OFF. SR (2)	39.0	0	0		
B06		BOP	02-35-1-L	OPS. OFF. SR (2)	31.5	0	0		
B05		B06	02-42-1-Q	FAN RM	45.0	0	0		
B05		B06	02-42-1-Q	FAN RM	12.0	0	0		
B05		B06	02A-14-0-Q	UPPER DECK UTILITY S	10.4	0	0		
B05		B06	02A-14-0-Q	UPPER DECK UTILITY S	8.4	0	0		
B06	B06		(none)	(weather bulkhead)	66.3	0	0		
B06	B06		(none)	(weather bulkhead)	20.4	0	0		
B05	B06		(none)	(weather bulkhead)	39.0	0	0		
B05	B06		(none)	(weather bulkhead)	76.5	0	0		
B06	B06		(none)	(weather bulkhead)	10.4	0	0		
B06	B06		(none)	(weather bulkhead)	20.4	0	0		
B06	B06		(none)	(weather bulkhead)	14.3	0	0		
B06	B06		(none)	(weather bulkhead)	4.4	0	0		
D00			3-34-0-E	MAIN GENERATOR RM	54.0	0	0		
D04			(none)	(weather overhead)	57.1	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-40-2-A	**CG LKR**	**(CUI = AG)**				
B05		B05	1-9-0B-L	PASSAGE	50.0	-30	-8	DJ	NC
B05		B06	1-34-2-Q	FAN ROOM	20.3	0	0		
B05		B06	1-40-4-T	UPTAKE	50.0	0	0		
B05		B05	1-44-2-Q	SCULLERY	20.3	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	22.2	0	0		
DOC			1A-34-2-Q	MAIN DECK UTILITY SP	22.2	0	0		
			1-40-3-A	**HALON CYLINDER STWG**	**(CUI = AS)**				
B05		BOP	1-34-1-L	WARDROOM	21.6	-30	-8	DJ	NC
B05		B06	1-40-1-T	UPTAKE	67.5	0	0		
B05		B06	1-40-1-T	UPTAKE	20.0	0	0		
B05		B05	1-42-1-Q	GALLEY	21.6	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	6.4	0	0		
B05		B06	1A-42-1-Q	MAIN DECK UTILITY SP	6.4	0	0		
B05	B06		(none)	(weather bulkhead)	67.5	0	0		
B05	B06		(none)	(weather bulkhead)	20.0	0	0		
D04			4-34-1-V	VOID	32.0	0	0		
D06			(none)	(weather overhead)	32.0	0	0		
			1-40-4-T	**UPTAKE**	**(CUI = TU)**				
B06		B06	1-34-2-Q	FAN ROOM	37.8	0	0		
B06		B06	1-34-2-Q	FAN ROOM	11.2	0	0		
B06		B05	1-40-2-A	CG LKR	50.0	0	0		
B06		B05	1-40-6-A	BAGGAGE STRM	67.5	0	0		
B06		B05	1-40-6-A	BAGGAGE STRM	20.0	0	0		
B06		B05	1-44-2-Q	SCULLERY	17.6	0	0		
B06		BOP	1-45-2-L	CREWS SR (6)	37.8	0	0		
B06		B05	1A-34-2-Q	MAIN DECK UTILITY SP	20.0	0	0		
B06		B05	1A-34-2-Q	MAIN DECK UTILITY SP	11.2	0	0		
B06		BOP	01-34-2-L	CREW SR (3)	36.4	0	0		
B06		BOP	01-34-2-L	CREW SR (3)	23.4	0	0		
B06		BOF	01-41-2-L	T/S	26.0	0	0		
B06		BOP	01-44-2-L	CREW SR (3)	23.4	0	0		
B06		BOP	01-44-2-L	CREW SR (3)	16.9	0	0		
B06		B06	01A-34-0-Q	FCSLE DECK UTILITY S	11.2	0	0		
B06		B05	01A-34-0-Q	FCSLE DECK UTILITY S	20.4	0	0		
B06		B05	01A-34-0-Q	FCSLE DECK UTILITY S	7.2	0	0		
B06		BOP	02-37-2-L	FIRST LT. SR (2)	42.0	0	0		
B06		BOP	02-37-2-L	FIRST LT. SR (2)	13.5	0	0		
B06		BOF	02-41-2-L	T/S	48.0	0	0		
B05		B06	02A-14-0-Q	UPPER DECK UTILITY S	11.2	0	0		
B05		B06	02A-14-0-Q	UPPER DECK UTILITY S	16.4	0	0		
B06	B06		(none)	(weather bulkhead)	66.3	0	0		
B06	B06		(none)	(weather bulkhead)	20.4	0	0		
B05	B06		(none)	(weather bulkhead)	76.5	0	0		
B05	B06		(none)	(weather bulkhead)	42.0	0	0		
B05	B06		(none)	(weather bulkhead)	20.4	0	0		
B05	B06		(none)	(weather bulkhead)	11.2	0	0		
B06	B06		(none)	(weather bulkhead)	13.0	0	0		
B06	B06		(none)	(weather bulkhead)	4.0	0	0		
B06	B06		(none)	(weather bulkhead)	15.0	0	0		
B05	B06		(none)	(weather bulkhead)	4.0	0	0		
D00			3-34-0-E	MAIN GENERATOR RM	54.0	0	0		
D04			(none)	(weather overhead)	57.1	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-40-6-A	**BAGGAGE STRM**	**(CUI = AS)**				
B05		B06	1-34-2-Q	FAN ROOM	23.0	0	0	DJ	NC
B05		B06	1-34-2-Q	FAN ROOM	6.8	0	0		
B05		B06	1-40-4-T	UPTAKE	67.5	0	0		
B05		B06	1-40-4-T	UPTAKE	20.0	0	0		
B05		BOP	1-45-2-L	CREWS SR (6)	23.0	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	6.8	0	0		
B05	B06		(none)	(weather bulkhead)	67.5	0	0		
B05	B06		(none)	(weather bulkhead)	20.0	0	0		
D04			4-34-2-V	VOID	32.0	0	0		
D06			(none)	(weather overhead)	34.0	0	0		
			1-42-1-Q	**GALLEY**	**(CUI = QG)**				
B05		B05	1-9-0B-L	PASSAGE	33.8	-99	-56	DJ	NC
B05		BOP	1-34-1-L	WARDROOM	36.5	0	0		
B05		BOP	1-34-1-L	WARDROOM	13.5	0	0		
B05		BOP	1-34-1-L	WARDROOM	21.6	-30	-8	DJ	NC
B05		BOP	1-34-1-L	WARDROOM	9.5	0	0		
B05		BOP	1-34-1-L	WARDROOM	27.0	-30	-8	DJ	NC
B05		B06	1-40-1-T	UPTAKE	31.1	0	0		
B05		B06	1-40-1-T	UPTAKE	37.8	0	0		
B05		B05	1-40-3-A	HALON CYLINDER STWG	21.6	0	0		
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	44.6	0	0		
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	87.8	0	0		
B05		BOP	1-52-1-L	CREWS MESSROOM	99.9	-60	-16	2 DJ	NC
B05	B06		(none)	(weather bulkhead)	94.5	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	225.4	0	0		
D04			4-34-1-V	VOID	47.6	0	0		
D03			1A-42-1-Q	MAIN DECK UTILITY SP	273.0	0	0		
			1-44-2-Q	**SCULLERY**	**(CUI = QG)**				
B05		B05	1-9-0B-L	PASSAGE	31.1	0	0		
B05		B05	1-9-0B-L	PASSAGE	47.3	0	0	DWT	Z
B05		B05	1-40-2-A	CG LKR	20.3	0	0		
B05		B06	1-40-4-T	UPTAKE	17.6	0	0		
B05		BOP	1-45-2-L	CREWS SR (6)	29.7	0	0		
B05		BOP	1-45-2-L	CREWS SR (6)	10.8	0	0		
B05		BOF	1-48-2-L	T/S	40.5	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	53.2	0	0		
D03			1A-34-2-Q	MAIN DECK UTILITY SP	53.2	0	0		
			1-45-2-L	**CREWS SR (6)**	**(CUI = L5)**				
BOP		BOP	1-9-0B-L	PASSAGE	40.5	-99	-56	DJ	NC
BOP		B06	1-40-4-T	UPTAKE	37.8	0	0		
BOP		B05	1-40-6-A	BAGGAGE STRM	23.0	0	0		
BOP		B05	1-44-2-Q	SCULLERY	29.7	0	0		
BOP		B05	1-44-2-Q	SCULLERY	10.8	0	0		
BOP		BOF	1-48-2-L	T/S	25.7	0	0		
BOP		BOF	1-48-2-L	T/S	18.4	-99	-56	DJ	NC
BOP		BOF	1-48-2-L	T/S	35.1	0	0		
BOP		BOP	1-54-2-L	CREWS SR (3)	110.7	0	0		
BOP	B06		(none)	(weather bulkhead)	116.1	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	109.5	0	0		
D04			4-34-2-V	VOID	47.6	0	0		
D04			4-52-4-F	FO SERV TANK	10.9	0	0		
D04			2-52-0-C	MAIN CONTROL STATION	41.6	0	0		
DOC			1A-34-2-Q	MAIN DECK UTILITY SP	211.3	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-46-1-T	**MCHRY ACCESS & REMOVAL TRNK**	**(CUI = TH)**				
B06		B05	1-9-0B-L	PASSAGE	87.8	0	0	DWT	Z
B06		B05	1-42-1-Q	GALLEY	44.6	0	0		
B06		B05	1-42-1-Q	GALLEY	87.8	0	0		
B06		BOP	1-52-1-L	CREWS MESSROOM	44.6	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	26.0	0	0		
B06		B05	1A-42-1-Q	MAIN DECK UTILITY SP	13.2	0	0		
B06		B05	1A-42-1-Q	MAIN DECK UTILITY SP	26.0	0	0		
B06		B05	1A-52-1-Q	MAIN DECK UTILITY SP	13.2	0	0		
B06		BOP	01-10-0B-L	PASSAGE	42.9	0	0		
B06		B05	01-10-0B-L	PASSAGE	79.3	0	0	DWT	Z
B06		BOF	01-46-1-L	T/S	57.2	0	0		
B06		BOP	01-47-1-L	CREW SR (3)	42.9	0	0		
B06		BOP	01-47-1-L	CREW SR (3)	22.1	0	0		
B05		B06	01A-34-0-Q	FCSLE DECK UTILITY S	24.4	-5	-5		
B05		B06	01A-34-1-Q	FCSLE DECK UTILITY S	13.2	0	0		
B05		B06	01A-34-1-Q	FCSLE DECK UTILITY S	24.4	0	0		
B05		B06	01A-34-1-Q	FCSLE DECK UTILITY S	13.2	0	0		
D00			3-34-0-E	MAIN GENERATOR RM	85.8	0	0		
D06			01-47-1-L	CREW SR (3)	5.3	0	0		
D06			(none)	(weather overhead)	80.5	0	0		
			1-48-2-L	**T/S**	**(CUI = LW)**				
BOF		BOP	1-9-0B-L	PASSAGE	45.9	0	0		
BOF		B05	1-44-2-Q	SCULLERY	40.5	0	0		
BOF		BOP	1-45-2-L	CREWS SR (6)	25.7	0	0		
BOF		BOP	1-45-2-L	CREWS SR (6)	18.4	-99	-56	DJ	NC
BOF		BOP	1-45-2-L	CREWS SR (6)	35.1	0	0		
D06			3-34-0-E	MAIN GENERATOR RM	39.0	0	0		
DOF			1A-34-2-Q	MAIN DECK UTILITY SP	39.0	0	0		
			1-52-1-L	**CREWS MESSROOM**	**(CUI = LL)**				
BOP		B05	1-9-0B-L	PASSAGE	129.6	-99	-56	DJ	NC
BOP		B05	1-42-1-Q	GALLEY	99.9	-60	-16	2 DJ	NC
BOP		B06	1-46-1-T	MCHRY ACCESS & REMOV	44.6	0	0		
BOP		B05	1-62-1-A	DC LKR	24.3	0	0		
BOP		B05	1-62-1-A	DC LKR	5.4	0	0		
BOP		B06	1-62-3-Q	GENERAL WORKSHOP	120.2	0	0		
BOP	B06		(none)	(weather bulkhead)	135.0	0	0		
D06			3-52-01-E	PROPULSION MTR RM	69.1	0	0		
D04			4-52-3-F	FO SERV TANK	54.4	0	0		
D04			4-60-1-F	LO TANK	13.6	0	0		
D06			2-52-0-C	MAIN CONTROL STATION	288.0	0	0		
DOC			1A-52-1-Q	MAIN DECK UTILITY SP	425.1	0	0		
			1-54-2-L	**CREWS SR (3)**	**(CUI = L5)**				
BOP		BOP	1-9-0B-L	PASSAGE	40.5	-99	-56	DJ	NC
BOP		BOP	1-45-2-L	CREWS SR (6)	110.7	0	0		
BOP		BOF	1-57-2-L	T/S	15.7	-99	-56	DJ	NC
BOP		BOF	1-57-2-L	T/S	27.0	0	0		
BOP		BOF	1-57-2-L	T/S	13.5	0	0		
BOP		BOP	1-58-2-L	CREWS SR (3)	70.2	0	0		
BOP	B06		(none)	(weather bulkhead)	62.1	0	0		
D04			4-52-4-F	FO SERV TANK	31.3	0	0		
D06			2-52-0-C	MAIN CONTROL STATION	101.6	0	0		
DOC			1A-34-2-Q	MAIN DECK UTILITY SP	132.9	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name	Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-57-2-L	**T/S**		(CUI = LW)				
BOF		BOP	1-9-0B-L		PASSAGE	44.6	0	0		
BOF		BOP	1-54-2-L		CREWS SR (3)	15.7	-99	-56	DJ	NC
BOF		BOP	1-54-2-L		CREWS SR (3)	27.0	0	0		
BOF		BOP	1-54-2-L		CREWS SR (3)	13.5	0	0		
BOF		BOP	1-58-2-L		CREWS SR (3)	13.5	0	0		
BOF		BOP	1-58-2-L		CREWS SR (3)	17.6	-99	-56	DJ	NC
BOF		BOP	1-58-2-L		CREWS SR (3)	25.7	0	0		
D04			2-52-0-C		MAIN CONTROL STATION	36.9	0	0		
DOF			1A-34-2-Q		MAIN DECK UTILITY SP	36.9	0	0		
			1-58-2-L		**CREWS SR (3)**	(CUI = L5)				
BOP		BOP	1-9-0B-L		PASSAGE	39.2	-99	-56	DJ	NC
BOP		BOP	1-54-2-L		CREWS SR (3)	70.2	0	0		
BOP		BOF	1-57-2-L		T/S	13.5	0	0		
BOP		BOF	1-57-2-L		T/S	17.6	-99	-56	DJ	NC
BOP		BOF	1-57-2-L		T/S	25.7	0	0		
BOP		BOP	1-63-2-L		CREWS SR (3)	110.7	0	0		
BOP	B06		(none)		(weather bulkhead)	62.1	0	0		
D06			3-52-01-E		PROPULSION MTR RM	72.8	0	0		
D04			4-52-4-F		FO SERV TANK	12.2	0	0		
D04			4-60-2-F		LO TANK	19.0	0	0		
D04			2-52-0-C		MAIN CONTROL STATION	27.9	0	0		
DOC			1A-34-2-Q		MAIN DECK UTILITY SP	132.0	0	0		
			1-62-1-A	**DC LKR**		(CUI = AG)				
B05		B05	1-9-0B-L		PASSAGE	32.4	-30	-8	DJ	NC
B05		BOP	1-52-1-L		CREWS MESSROOM	24.3	0	0		
B05		BOP	1-52-1-L		CREWS MESSROOM	5.4	0	0		
B05		B06	1-62-3-Q		GENERAL WORKSHOP	24.3	0	0		
B05		B06	1-62-3-Q		GENERAL WORKSHOP	27.0	0	0		
B05		B05	1-62-3-Q		GENERAL WORKSHOP	7.2	0	0		
B05		B05	1-62-3-Q		GENERAL WORKSHOP	8.0	0	0		
B05		B05	1A-34-2-Q		MAIN DECK UTILITY SP	9.6	-5	-5		
B05		B05	1A-52-1-Q		MAIN DECK UTILITY SP	7.2	0	0		
B05		B05	1A-52-1-Q		MAIN DECK UTILITY SP	1.6	0	0		
D06			3-52-01-E		PROPULSION MTR RM	17.3	0	0		
D06			01-61-0-L		TRAINING RM/ CREWS L	17.3	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-62-3-Q	**GENERAL WORKSHOP**	**(CUI = QS)**				
B05		B06	1-9-0B-L	PASSAGE	44.6	-30	-8	DJ	NC
B06		BOP	1-52-1-L	CREWS MESSROOM	120.2	0	0		
B06		B05	1-62-1-A	DC LKR	24.3	0	0		
B06		B05	1-62-1-A	DC LKR	27.0	0	0		
B05		B05	1-62-1-A	DC LKR	7.2	0	0		
B05		B05	1-62-1-A	DC LKR	8.0	0	0		
B05		B06	1-68-1-L	STWY	24.3	0	0		
B06		B05	1-68-1-L	STWY	7.2	0	0		
B05		B06	1-68-3-Q	FAN ROOM	120.2	0	0	2 DWT	X
B06		B06	1-68-3-Q	FAN ROOM	35.6	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	13.2	-5	-5		
B05		B05	1A-52-1-Q	MAIN DECK UTILITY SP	35.6	0	0		
B05	B06		(none)	(weather bulkhead)	71.6	0	0		
B05	B06		(none)	(weather bulkhead)	21.2	0	0		
D06			3-52-01-E	PROPULSION MTR RM	176.4	0	0		
D04			4-60-1-F	LO TANK	27.2	0	0		
D04			4-66-1-F	OILY WASTE TK	8.8	0	0		
D06			01-61-0-L	TRAINING RM/ CREWS L	148.8	0	0		
D06			(none)	(weather overhead)	63.6	0	0		
			1-63-2-L	**CREWS SR (3)**	**(CUI = L5)**				
BOP		BOP	1-9-0B-L	PASSAGE	39.2	-99	-56	DJ	NC
BOP		BOP	1-58-2-L	CREWS SR (3)	110.7	0	0		
BOP		BOF	1-66-2-L	T/S	16.5	-99	-56	DJ	NC
BOP		BOF	1-66-2-L	T/S	27.0	0	0		
BOP		BOF	1-66-2-L	T/S	14.9	0	0		
BOP		BOP	1-68-2-L	CREWS SR (3)	70.2	0	0		
BOP	B06		(none)	(weather bulkhead)	63.5	0	0		
D06			3-52-01-E	PROPULSION MTR RM	102.0	0	0		
D04			4-60-2-F	LO TANK	21.8	0	0		
D04			4-66-2-F	OILY WASTE TANK	10.2	0	0		
DOC			1A-34-2-Q	MAIN DECK UTILITY SP	134.0	0	0		
			1-66-2-L	**T/S**	**(CUI = LW)**				
BOF		BOP	1-9-0B-L	PASSAGE	45.9	0	0		
BOF		BOP	1-63-2-L	CREWS SR (3)	16.5	-99	-56	DJ	NC
BOF		BOP	1-63-2-L	CREWS SR (3)	27.0	0	0		
BOF		BOP	1-63-2-L	CREWS SR (3)	14.9	0	0		
BOF		BOP	1-68-2-L	CREWS SR (3)	13.5	0	0		
BOF		BOP	1-68-2-L	CREWS SR (3)	15.7	-99	-56	DJ	NC
BOF		BOP	1-68-2-L	CREWS SR (3)	27.0	0	0		
D06			3-52-01-E	PROPULSION MTR RM	38.2	0	0		
DOF			1A-34-2-Q	MAIN DECK UTILITY SP	38.2	0	0		
			1-68-1-L	**STWY**	**(CUI = LP)**				
B05		B05	1-9-0B-L	PASSAGE	63.5	0	0	DW	Z
B06		B05	1-62-3-Q	GENERAL WORKSHOP	24.3	0	0		
B05		B06	1-62-3-Q	GENERAL WORKSHOP	7.2	0	0		
B05		B06	1-68-3-Q	FAN ROOM	63.5	0	0		
B05		B06	1-68-3-Q	FAN ROOM	18.8	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	18.8	-5	-5		
B05	B06		(none)	(weather bulkhead)	24.3	0	0		
B05	B06		(none)	(weather bulkhead)	7.2	0	0		
D00			3-52-01-E	PROPULSION MTR RM	33.8	0	0		
D06			01-61-0-L	TRAINING RM/ CREWS L	5.8	0	0		
D06			01-68-0-Q	ELECTRONICS & ELECTR	28.1	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1-68-3-Q	**FAN ROOM**	**(CUI = QF)**				
B06		B05	1-62-3-Q	GENERAL WORKSHOP	120.2	0	0	2 DWT	X
B06		B06	1-62-3-Q	GENERAL WORKSHOP	35.6	0	0		
B06		B05	1-68-1-L	STWY	63.5	0	0		
B06		B05	1-68-1-L	STWY	18.8	0	0		
B05	B06		(none)	(weather bulkhead)	120.2	0	0		
B05	B06		(none)	(weather bulkhead)	63.5	0	0		
B06	B06		(none)	(weather bulkhead)	35.6	0	0		
B06	B06		(none)	(weather bulkhead)	18.8	0	0		
D06			3-52-01-E	PROPULSION MTR RM	135.4	0	0		
D04			4-66-1-F	OILY WASTE TK	32.0	0	0		
D06			01-61-0-L	TRAINING RM/ CREWS L	21.7	0	0		
D06			01-68-0-Q	ELECTRONICS & ELECTR	37.4	0	0		
D06			01-69-1-Q	HYD. POWER RM.	51.8	0	0		
D06			(none)	(weather overhead)	56.4	0	0		
			1-68-2-L	**CREWS SR (3)**	**(CUI = L5)**				
BOP		BOP	1-9-0B-L	PASSAGE	39.2	-99	-56	DJ	NC
BOP		BOP	1-63-2-L	CREWS SR (3)	70.2	0	0		
BOP		BOF	1-66-2-L	T/S	13.5	0	0		
BOP		BOF	1-66-2-L	T/S	15.7	-99	-56	DJ	NC
BOP		BOF	1-66-2-L	T/S	27.0	0	0		
BOP	B06		(none)	(weather bulkhead)	60.8	0	0		
BOP	B06		(none)	(weather bulkhead)	110.7	0	0		
D06			3-52-01-E	PROPULSION MTR RM	99.0	0	0		
D04			4-66-2-F	OILY WASTE TANK	30.6	0	0		
DOC			1A-34-2-Q	MAIN DECK UTILITY SP	129.6	0	0		
			1-72-2-L	**VESTIBULE**	**(CUI = LP)**				
B05		B05	1-9-0B-L	PASSAGE	33.8	0	0	DW	Z
B05		B06	1-75-0-Q	D.C. SHOP	43.8	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	10.0	0	0		
B05	B06		(none)	(weather bulkhead)	50.8	0	0	DW	Z
B05	B06		(none)	(weather bulkhead)	50.8	0	0	DW	Z
D04			2-72-0-W	ANTI-ROLL TANK	29.0	0	0		
D06			(none)	(weather overhead)	29.0	0	0		
			1-75-0-Q	**D.C. SHOP**	**(CUI = QS)**				
B06		B05	1-72-2-L	VESTIBULE	43.8	0	0		
B05	B06		(none)	(weather bulkhead)	89.3	0	0		
B05	B06		(none)	(weather bulkhead)	206.5	0	0	DW	Z
B05	B06		(none)	(weather bulkhead)	89.3	0	0		
B05	B06		(none)	(weather bulkhead)	89.3	0	0		
B05	B06		(none)	(weather bulkhead)	73.5	0	0		
D06			3-72-1-L	TUNNEL	30.0	0	0		
D04			4-72-1-F	FUEL OIL TANK	31.2	0	0		
D04			4-72-2-F	FUEL OIL TANK	61.2	0	0		
D04			4-72-4-F	FUEL OIL TANK	19.2	0	0		
D04			2-72-0-W	ANTI-ROLL TANK	99.1	0	0		
D06			(none)	(weather overhead)	240.7	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1A-14-0-Q	**MAIN DECK UTILITY SPACE NO.2**	**(CUI = QF)**				
B05		B05	1-6-4-Q	SHIP STORE	22.0	0	0		
B05		B05	1-9-0-L	PASSAGE	10.0	-5	-5		
B05		B05	1-22-1-L	STWY	28.8	0	0		
B05		B05	1-22-1-L	STWY	8.0	0	0		
B05		B05	1-22-1-L	STWY	28.8	0	0		
B05		B06	1-34-2-Q	FAN ROOM	33.2	0	0		
B05		B05	1A-14-1-Q	MAIN DECK UTILITY SP	30.8	0	0		
B05		B05	1A-14-1-Q	MAIN DECK UTILITY SP	32.0	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	42.8	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	10.0	0	0		
B05	B06		(none)	(weather bulkhead)	40.7	0	0		
B05	B06		(none)	(weather bulkhead)	20.1	0	0		
B05	B06		(none)	(weather bulkhead)	20.0	0	0		
B05	B06		(none)	(weather bulkhead)	20.0	0	0		
B05	B06		(none)	(weather bulkhead)	28.2	0	0		
DOC			1-9-0A-L	PASSAGE	269.2	0	0		
DOC			1-14-2-L	RECREATION ROOM	238.2	0	0		
DOC			1-22-3-L	EXERCISE RM	226.8	0	0		
DOC			1-24-2-L	CREWS SR (3)	126.8	0	0		
DOC			1-28-2-A	CBR LKR	17.2	0	0		
DOF			1-28-4-L	T/S	35.5	0	0		
DOC			1-30-1-L	HOSPITAL	128.0	0	0		
DOC			1-30-2-L	CREWS SR (3)	137.5	0	0		
DOF			1-32-1-L	T/S	33.0	0	0		
D06			01-10-0A-L	PASSAGE	228.0	0	0		
D06			01-14-2-L	T/S	39.7	0	0		
D06			01-14-4-L	CREW SR (2)	114.4	0	0		
D06			01-19-1-L	CREW SR (2)	42.3	0	0		
D06			01-21-2-L	CREW SR (2)	139.3	0	0		
D06			01-24-1-L	CREW SR (2)	123.7	0	0		
D06			01-26-2-L	T/S	36.6	0	0		
D06			01-27-1-L	T/S	39.6	0	0		
D06			01-28-2-L	CREW SR (3)	146.5	0	0		
D06			01-30-1-L	CREW SR (2)	135.9	0	0		
D06			(none)	(weather overhead)	166.1	0	0		
			1A-14-1-Q	**MAIN DECK UTILITY SPACE NO.1**	**(CUI = QF)**				
B05		B05	1-6-3-A	DRY PROVISIONS STRM	28.0	0	0		
B05		B05	1-9-0-L	PASSAGE	4.0	0	0		
B05		B05	1-22-1-L	STWY	8.0	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	30.8	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	32.0	0	0		
B05	B06		(none)	(weather bulkhead)	15.9	0	0		
B05	B06		(none)	(weather bulkhead)	16.9	0	0		
D03			1-14-1-A	FREEZE ROOM	139.4	0	0		
D03			1-18-1-A	THAW ROOM	35.9	0	0		
D03			1-18-3-A	CHILL ROOM	110.0	0	0		
D06			01-14-1-L	CREW SR (2)	131.0	0	0		
D06			01-17-1-L	T/S	38.1	0	0		
D06			01-19-1-L	CREW SR (2)	87.5	0	0		
D06			(none)	(weather overhead)	28.7	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1A-34-1-Q	**MAIN DECK UTILITY SPACE NO.3**	**(CUI = QF)**				
B05		B06	1-40-1-T	UPTAKE	11.2	0	0		
B05		B06	1-40-1-T	UPTAKE	10.8	0	0		
B05		B05	1-40-3-A	HALON CYLINDER STWG	6.4	0	0		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	42.8	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	36.0	-5	-5		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	10.8	0	0		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	4.0	0	0		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	6.4	0	0		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	2.8	0	0		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	8.0	0	0		
B05	B06		(none)	(weather bulkhead)	24.0	0	0		
DOC			1-34-1-L	WARDROOM	323.6	0	0		
D06			01-10-0B-L	PASSAGE	10.4	0	0		
D06			01-34-1-L	T/S	39.6	0	0		
D06			01-34-3-L	CREW SR (3)	164.7	0	0		
D06			01-40-1-A	SPONSOR STRM	69.3	0	0		
D06			(none)	(weather overhead)	38.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1A-34-2-Q	**MAIN DECK UTILITY SPACE NO.4**	**(CUI = QF)**				
B05		B06	1-34-2-Q	FAN ROOM	24.0	0	0		
B05		B06	1-34-2-Q	FAN ROOM	15.2	0	0		
B05		B06	1-40-4-T	UPTAKE	20.0	0	0		
B05		B06	1-40-4-T	UPTAKE	11.2	0	0		
B05		B05	1-40-6-A	BAGGAGE STRM	6.8	0	0		
B05		B05	1-46-1-T	MCHRY ACCESS & REMOV	26.0	0	0		
B05		B05	1-62-1-A	DC LKR	9.6	-5	-5		
B05		B05	1-62-3-Q	GENERAL WORKSHOP	13.2	-5	-5		
B05		B05	1-68-1-L	STWY	18.8	-5	-5		
B05		B05	1A-14-0-Q	MAIN DECK UTILITY SP	10.0	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	36.0	-5	-5		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	10.0	-5	-5		
B05		B05	1A-52-1-Q	MAIN DECK UTILITY SP	38.4	-5	-5		
B05		B05	1-72-2-L	VESTIBULE	10.0	0	0		
B05	B06		(none)	(weather bulkhead)	0.0	0	0		
B05	B06		(none)	(weather bulkhead)	108.0	0	0		
DOC			1-9-0B-L	PASSAGE	414.0	0	0		
DOC			1-40-2-A	CG LKR	22.2	0	0		
D03			1-44-2-Q	SCULLERY	53.2	0	0		
DOC			1-45-2-L	CREWS SR (6)	211.3	0	0		
DOF			1-48-2-L	T/S	39.0	0	0		
DOC			1-54-2-L	CREWS SR (3)	132.9	0	0		
DOF			1-57-2-L	T/S	36.9	0	0		
DOC			1-58-2-L	CREWS SR (3)	132.0	0	0		
DOC			1-63-2-L	CREWS SR (3)	134.0	0	0		
DOF			1-66-2-L	T/S	38.2	0	0		
DOC			1-68-2-L	CREWS SR (3)	129.6	0	0		
D06			01-10-0B-L	PASSAGE	263.4	0	0		
D06			01-34-2-L	CREW SR (3)	16.1	0	0		
D06			01-41-2-L	T/S	35.9	0	0		
D06			01-44-2-L	CREW SR (3)	156.6	0	0		
D06			01-54-2-L	VESTIBULE	61.0	0	0		
D06			01-54-4-A	CG LKR	26.0	0	0		
D06			01-54-6-L	T/S	44.7	0	0		
D06			01-57-2-L	PASSENGER BERTHING (	201.3	0	0		
D06			01-61-0-L	TRAINING RM/ CREWS L	19.2	0	0		
D06			01-61-2-L	PASSAGE	60.8	0	0		
D06			01-64-2-K	ARMORY/LAW ENFORCEME	111.5	0	0		
D06			01-68-0-Q	ELECTRONICS & ELECTR	145.1	0	0		
D06			(none)	(weather overhead)	203.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			1A-42-1-Q	**MAIN DECK UTILITY SPACE NO.5**	**(CUI = QF)**				
B06		B06	1-40-1-T	UPTAKE	9.2	0	0		
B06		B06	1-40-1-T	UPTAKE	11.2	0	0		
B06		B05	1-40-3-A	HALON CYLINDER STWG	6.4	0	0		
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	13.2	0	0		
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	26.0	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	10.8	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	4.0	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	6.4	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	2.8	0	0		
B05		B05	1A-34-1-Q	MAIN DECK UTILITY SP	8.0	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	10.0	-5	-5		
B05		B05	1A-52-1-Q	MAIN DECK UTILITY SP	29.6	0	0		
B05	B06		(none)	(weather bulkhead)	28.0	0	0		
D03			1-42-1-Q	GALLEY	273.0	0	0		
D06			01-10-0B-L	PASSAGE	66.2	0	0		
D06			01-40-1-A	SPONSOR STRM	26.4	0	0		
D06			01-46-1-L	T/S	32.8	0	0		
D06			01-47-1-L	CREW SR (3)	72.0	0	0		
D06			(none)	(weather overhead)	75.6	0	0		
			1A-52-1-Q	**MAIN DECK UTILITY SPACE NO.7**	**(CUI = QF)**				
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	13.2	0	0		
B05		B05	1-62-1-A	DC LKR	7.2	0	0		
B05		B05	1-62-1-A	DC LKR	1.6	0	0		
B05		B05	1-62-3-Q	GENERAL WORKSHOP	35.6	0	0		
B05		B05	1A-34-2-Q	MAIN DECK UTILITY SP	38.4	-5	-5		
B05		B05	1A-42-1-Q	MAIN DECK UTILITY SP	29.6	0	0		
B05	B06		(none)	(weather bulkhead)	40.0	0	0		
DOC			1-52-1-L	CREWS MESSROOM	425.1	0	0		
D06			01-47-1-L	CREW SR (3)	64.0	0	0		
D06			01-54-1-C	COMMUNICATION CTR	195.2	0	0		
D06			01-61-0-L	TRAINING RM/ CREWS L	55.6	0	0		
D06			(none)	(weather overhead)	110.3	0	0		
			01-G-0-A	**BOSUN STORES**	**(CUI = AS)**				
B05		B05	01-1-2-A	STRM NO 2	61.2	0	0		
B05		B05	01-1-2-A	STRM NO 2	17.0	0	0		
B01		B01	01-2-0-L	PASSAGE	37.4	0	0	DO	O
B01		B01	01-2-1-A	STRM NO 1	69.7	0	0		
B05	B06		(none)	(weather bulkhead)	127.2	0	0		
B05	B06		(none)	(weather bulkhead)	147.9	0	0		
D06			1-D-0-A	STEWARD STOREROOM	35.9	0	0		
D06			(none)	(weather overhead)	131.4	0	0		
			01-1-2-A	**STRM NO 2**	**(CUI = AS)**				
B05		B05	01-G-0-A	BOSUN STORES	61.2	0	0		
B05		B05	01-G-0-A	BOSUN STORES	17.0	0	0		
B05		B05	01-2-0-L	PASSAGE	68.0	-99	-56	DJ	NC
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	100.3	0	0		
B05	B06		(none)	(weather bulkhead)	93.6	0	0		
D06			1-D-0-A	STEWARD STOREROOM	50.1	0	0		
D06			(none)	(weather overhead)	95.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft^2	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-2-0-L	**PASSAGE**	**(CUI = LP)**				
B01		B01	01-G-0-A	BOSUN STORES	37.4	0	0	DO	O
B05		B05	01-1-2-A	STRM NO 2	68.0	-99	-56	DJ	NC
B01		B01	01-2-1-A	STRM NO 1	68.0	0	0	DO	O
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	37.4	0	0	DWT	Z
D06			1-D-0-A	STEWARD STOREROOM	35.2	0	0		
D06			(none)	(weather overhead)	35.2	0	0	HS	Y
			01-2-1-A	**STRM NO 1**	**(CUI = AS)**				
B01		B01	01-G-0-A	BOSUN STORES	69.7	0	0		
B01		B01	01-2-0-L	PASSAGE	68.0	0	0	DO	O
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	96.9	0	0		
B05	B06		(none)	(weather bulkhead)	73.2	0	0		
D06			1-D-0-A	STEWARD STOREROOM	42.0	0	0	HO	O
D06			(none)	(weather overhead)	78.4	0	0		
			01-6-0-Q	**EMER SWBD & GEN RM**	**(CUI = QE)**				
B06		B05	01-1-2-A	STRM NO 2	100.3	0	0		
B06		B05	01-2-0-L	PASSAGE	37.4	0	0	DWT	Z
B06		B05	01-2-1-A	STRM NO 1	96.9	0	0		
B06		B05	01-10-0-L	PASSAGE	23.8	0	0		
B06		B05	01-10-0-L	PASSAGE	13.6	0	0		
B06		B05	01-10-0-L	PASSAGE	20.5	0	0		
B06		B05	01-10-0-L	PASSAGE	39.1	0	0	DWT	Z
B06		B05	01-10-0-L	PASSAGE	42.5	0	0		
B06		B05	01-10-0-L	PASSAGE	13.6	0	0		
B05	B06		(none)	(weather bulkhead)	104.9	0	0		
B05	B06		(none)	(weather bulkhead)	115.6	0	0		
B05	B06		(none)	(weather bulkhead)	117.3	0	0		
B05	B06		(none)	(weather bulkhead)	96.9	0	0		
D06			1-6-1-A	CHAIN LKR	32.4	0	0		
D06			1-6-2-A	CHAIN LKR	33.6	0	0		
D06			1-6-3-A	DRY PROVISIONS STRM	114.8	0	0		
D06			1-6-4-Q	SHIP STORE	83.0	0	0		
D06			1-9-0-L	PASSAGE	21.9	0	0		
D06			(none)	(weather overhead)	366.4	0	0		
			01-10-0-L	**PASSAGE**	**(CUI = LP)**				
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	23.8	0	0		
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	13.6	0	0		
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	20.5	0	0		
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	39.1	0	0	DWT	Z
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	42.5	0	0		
B05		B06	01-6-0-Q	EMER SWBD & GEN RM	13.6	0	0		
B05		B05	01-10-0A-L	PASSAGE	32.5	0	0	DO	O
B05		BOP	01-14-1-L	CREW SR (2)	26.0	0	0		
B05		BOF	01-14-2-L	T/S	6.5	0	0		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	8.0	0	0		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	12.0	0	0		
B05	B06		(none)	(weather bulkhead)	35.7	0	0	DWT	Z
B05	B06		(none)	(weather bulkhead)	25.5	0	0	DWT	Z
D06			1-6-3-A	DRY PROVISIONS STRM	8.0	0	0		
D06			1-6-4-Q	SHIP STORE	4.2	0	0		
D06			1-9-0-L	PASSAGE	48.1	0	0	HL	Z
D06			(none)	(weather overhead)	60.3	0	0	HL	Y

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-10-0A-L	PASSAGE	(CUI	= LP)			
B05		B05	1-22-1-L	STWY	30.6	0	0	DWT	Z
B05		B05	01-10-0-L	PASSAGE	32.5	0	0	DO	O
B05		B05	01-10-0B-L	PASSAGE	32.5	0	0	DO	O
B05		BOP	01-14-1-L	CREW SR (2)	40.3	-99	-56	DJ	NC
BOP		BOF	01-14-2-L	T/S	40.3	0	0		
BOP		BOP	01-14-4-L	CREW SR (2)	53.3	-99	-56	DJ	NC
B05		BOF	01-17-1-L	T/S	41.6	0	0		
B05		BOP	01-19-1-L	CREW SR (2)	22.1	-99	-56	DJ	NC
BOP		BOP	01-21-2-L	CREW SR (2)	59.8	-99	-56	DJ	NC
B05		B05	01-22-1-L	STAIRWAY	26.0	0	0		
B05		B05	01-22-1-L	STAIRWAY	46.8	0	0	DWT	Z
B05		B05	01-22-1-L	STAIRWAY	16.2	0	0		
BOP		BOP	01-24-1-L	CREW SR (2)	19.5	-99	-56	DJ	NC
BOP		BOF	01-26-2-L	T/S	44.2	0	0		
BOP		BOP	01-28-2-L	CREW SR (3)	62.4	-99	-56	DJ	NC
BOP		BOP	01-30-1-L	CREW SR (2)	26.0	0	0		
BOP		BOP	01-30-1-L	CREW SR (2)	26.7	-99	-56	DJ	NC
BOP		BOP	01-30-1-L	CREW SR (2)	11.7	0	0		
B05		BOP	01-30-1-L	CREW SR (2)	32.5	-99	-56		
D06			1A-14-0-Q	MAIN DECK UTILITY SP	228.0	0	0		
DOC			01A-14-1-Q	FCSLE DECK UTILITY S	28.0	0	0		
DOC			01A-14-2-Q	FCSLE DECK UTILITY S	200.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-10-0B-L	**PASSAGE**	(CUI = LP)				
BOP		B06	1-40-1-T	UPTAKE	22.1	0	0		
BOP		B06	1-40-1-T	UPTAKE	16.9	0	0		
BOP		B06	1-46-1-T	MCHRY ACCESS & REMOV	42.9	0	0		
B05		B06	1-46-1-T	MCHRY ACCESS & REMOV	79.3	0	0	DWT	Z
B05		B05	01-10-0A-L	PASSAGE	32.5	0	0	DO	O
B05		BOP	01-30-1-L	CREW SR (2)	16.9	0	0		
B05		BOF	01-34-1-L	T/S	26.0	0	0		
BOP		BOP	01-34-2-L	CREW SR (3)	52.0	-99	-56	DJ	NC
BOP		BOP	01-34-2-L	CREW SR (3)	10.4	0	0		
BOP		B05	01-34-2A-T	VENT TRUNK	39.0	0	0		
B05		BOP	01-34-3-L	CREW SR (3)	16.9	0	0		
B05		BOP	01-34-3-L	CREW SR (3)	50.7	-99	-56	DJ	NC
BOP		BOP	01-40-1-A	SPONSOR STRM	81.9	0	0		
B05		BOP	01-40-1-A	SPONSOR STRM	49.4	-99	-56	DJ	NC
BOP		BOF	01-41-2-L	T/S	42.9	0	0		
BOP		BOP	01-44-2-L	CREW SR (3)	10.4	0	0		
BOP		BOP	01-44-2-L	CREW SR (3)	94.9	-99	-56	DJ	NC
BOP		BOP	01-44-2-L	CREW SR (3)	71.5	0	0		
BOP		BOF	01-46-1-L	T/S	18.2	0	0		
BOP		BOF	01-46-1-L	T/S	10.2	0	0		
BOP		BOF	01-46-1-L	T/S	11.7	0	0		
BOP		BOP	01-47-1-L	CREW SR (3)	36.4	0	0		
B05		BOP	01-47-1-L	CREW SR (3)	31.2	-99	-56	DJ	NC
B05		B05	01-54-2-L	VESTIBULE	32.5	0	0	DJ	NC
B05		B05	01-54-4-A	CG LKR	32.5	-30	-8	DJ	NC
B05		BOF	01-54-6-L	T/S	39.0	0	0		
BOP	B06		(none)	(weather bulkhead)	31.2	0	0	DWT	Z
BOP	B06		(none)	(weather bulkhead)	26.0	0	0	DWT	Z
D06			1A-34-1-Q	MAIN DECK UTILITY SP	10.4	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	263.4	0	0		
D06			1A-42-1-Q	MAIN DECK UTILITY SP	66.2	0	0		
DOC			01A-34-0-Q	FCSLE DECK UTILITY S	273.8	0	0		
DOC			01A-34-1-Q	FCSLE DECK UTILITY S	66.2	0	0		
			01-14-1-L	**CREW SR (2)**	(CUI = L2)				
BOP		B05	01-10-0-L	PASSAGE	26.0	0	0		
BOP		B05	01-10-0A-L	PASSAGE	40.3	-99	-56	DJ	NC
BOP		BOF	01-17-1-L	T/S	26.0	0	0		
BOP		BOF	01-17-1-L	T/S	16.9	-99	-56	DJ	NC
BOP		BOF	01-17-1-L	T/S	16.9	0	0		
BOP		BOP	01-19-1-L	CREW SR (2)	65.0	0	0		
BOP	B06		(none)	(weather bulkhead)	64.5	0	0	DJ	NC
BOP	B06		(none)	(weather bulkhead)	70.2	0	0		
D06			1A-14-1-Q	MAIN DECK UTILITY SP	131.0	0	0		
DOC			01A-14-1-Q	FCSLE DECK UTILITY S	131.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-14-2-L	**T/S**	**(CUI = LW)**				
BOF		B05	01-10-0-L	PASSAGE	6.5	0	0		
BOF		BOP	01-10-0A-L	PASSAGE	40.3	0	0		
BOF		BOP	01-14-4-L	CREW SR (2)	32.5	0	0		
BOF		BOP	01-14-4-L	CREW SR (2)	15.2	-99	-56	DJ	NC
BOF		BOP	01-14-4-L	CREW SR (2)	29.9	0	0		
BOF	B06		(none)	(weather bulkhead)	36.4	0	0		
D06			1A-14-0-Q	MAIN DECK UTILITY SP	39.7	0	0		
DOF			01A-14-2-Q	FCSLE DECK UTILITY S	39.7	0	0		
			01-14-4-L	**CREW SR (2)**	**(CUI = L2)**				
BOP		BOP	01-10-0A-L	PASSAGE	53.3	-99	-56	DJ	NC
BOP		BOF	01-14-2-L	T/S	32.5	0	0		
BOP		BOF	01-14-2-L	T/S	15.2	-99	-56	DJ	NC
BOP		BOF	01-14-2-L	T/S	29.9	0	0		
BOP		BOP	01-21-2-L	CREW SR (2)	76.7	0	0		
BOP	B06		(none)	(weather bulkhead)	94.7	0	0	2 DJ	NC
BOP	B06		(none)	(weather bulkhead)	19.5	0	0		
D06			1A-14-0-Q	MAIN DECK UTILITY SP	114.4	0	0		
DOC			01A-14-2-Q	FCSLE DECK UTILITY S	114.4	0	0		
			01-17-1-L	**T/S**	**(CUI = LW)**				
BOF		B05	01-10-0A-L	PASSAGE	41.6	0	0		
BOF		BOP	01-14-1-L	CREW SR (2)	26.0	0	0		
BOF		BOP	01-14-1-L	CREW SR (2)	16.9	-99	-56	DJ	NC
BOF		BOP	01-14-1-L	CREW SR (2)	16.9	0	0		
BOF		BOP	01-19-1-L	CREW SR (2)	26.0	0	0		
BOF		BOP	01-19-1-L	CREW SR (2)	18.1	-99	-56	DJ	NC
BOF		BOP	01-19-1-L	CREW SR (2)	9.1	0	0		
D06			1A-14-1-Q	MAIN DECK UTILITY SP	38.1	0	0		
DOF			01A-14-1-Q	FCSLE DECK UTILITY S	38.1	0	0		
			01-19-1-L	**CREW SR (2)**	**(CUI = L2)**				
BOP		B05	1-22-1-L	STWY	17.0	0	0		
BOP		B05	1-22-1-L	STWY	13.6	0	0		
BOP		B05	01-10-0A-L	PASSAGE	22.1	-99	-56	DJ	NC
BOP		BOP	01-14-1-L	CREW SR (2)	65.0	0	0		
BOP		BOF	01-17-1-L	T/S	26.0	0	0		
BOP		BOF	01-17-1-L	T/S	18.1	-99	-56	DJ	NC
BOP		BOF	01-17-1-L	T/S	9.1	0	0		
BOP		B05	01-22-1-L	STAIRWAY	9.0	0	0		
BOP		B05	01-22-1-L	STAIRWAY	7.2	0	0		
BOP		BOP	01-24-1-L	CREW SR (2)	87.1	0	0		
BOP	B06		(none)	(weather bulkhead)	61.4	0	0	DJ	NC
D06			1A-14-0-Q	MAIN DECK UTILITY SP	42.3	0	0		
D06			1A-14-1-Q	MAIN DECK UTILITY SP	87.5	0	0		
DOC			01A-14-1-Q	FCSLE DECK UTILITY S	129.8	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-21-2-L	**CREW SR (2)**	**(CUI = L2)**				
BOP		BOP	01-10-0A-L	PASSAGE	59.8	-99	-56	DJ	NC
BOP		BOP	01-14-4-L	CREW SR (2)	76.7	0	0		
BOP		BOF	01-26-2-L	T/S	15.9	-99	-56	DJ	NC
BOP		BOF	01-26-2-L	T/S	24.7	0	0		
BOP		BOF	01-26-2-L	T/S	15.6	0	0		
BOP		BOP	01-28-2-L	CREW SR (3)	45.5	0	0		
BOP	B06		(none)	(weather bulkhead)	84.8	0	0		
D06			1A-14-0-Q	MAIN DECK UTILITY SP	139.3	0	0		
DOC			01A-14-2-Q	FCSLE DECK UTILITY S	139.3	0	0		
			01-22-1-L	**STAIRWAY**	**(CUI = LP)**				
B05		B05	1-22-1-L	STWY	17.0	0	0		
B05		B05	01-10-0A-L	PASSAGE	26.0	0	0		
B05		B05	01-10-0A-L	PASSAGE	46.8	0	0	DWT	Z
B05		B05	01-10-0A-L	PASSAGE	16.2	0	0		
B05		BOP	01-19-1-L	CREW SR (2)	9.0	0	0		
B05		BOP	01-19-1-L	CREW SR (2)	7.2	0	0		
B05		BOP	01-24-1-L	CREW SR (2)	46.8	0	0		
B05		BOP	01-24-1-L	CREW SR (2)	9.0	0	0		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	8.0	0	0		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	28.8	0	0		
BOP		B06	01A-14-1-Q	FCSLE DECK UTILITY S	8.0	0	0		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	28.8	-5	-5		
B05		B05	02-20-0-L	PASSAGE	18.0	0	0		
B05		B05	02-20-0-L	PASSAGE	32.4	0	0	DWT	Z
B05		BOP	02-22-1-Q	SHIP'S OFFICE & SUPP	32.4	0	0		
B05		B05	02-25-1-L	STAIRWAY	18.0	0	0		
D04			1-22-1-L	STWY	28.8	0	0		
D04			1-22-1-L	STWY	28.8	0	0		
D06			02-25-1-L	STAIRWAY	28.8	0	0		
D04			02-25-1-L	STAIRWAY	28.8	0	0		
			01-24-1-L	**CREW SR (2)**	**(CUI = L2)**				
BOP		B05	1-22-1-L	STWY	17.0	0	0		
BOP		BOP	01-10-0A-L	PASSAGE	19.5	-99	-56	DJ	NC
BOP		BOP	01-19-1-L	CREW SR (2)	87.1	0	0		
BOP		B05	01-22-1-L	STAIRWAY	46.8	0	0		
BOP		B05	01-22-1-L	STAIRWAY	9.0	0	0		
BOP		BOF	01-27-1-L	T/S	15.9	-99	-56	DJ	NC
BOP		BOF	01-27-1-L	T/S	27.3	0	0		
BOP		BOF	01-27-1-L	T/S	23.4	0	0		
BOP		BOP	01-30-1-L	CREW SR (2)	29.9	0	0		
BOP	B06		(none)	(weather bulkhead)	40.4	0	0	DJ	NC
D06			1A-14-0-Q	MAIN DECK UTILITY SP	123.7	0	0		
DOC			01A-14-1-Q	FCSLE DECK UTILITY S	123.7	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-26-2-L	**T/S**	**(CUI = LW)**				
BOF		BOP	01-10-0A-L	PASSAGE	44.2	0	0		
BOF		BOP	01-21-2-L	CREW SR (2)	15.9	-99	-56	DJ	NC
BOF		BOP	01-21-2-L	CREW SR (2)	24.7	0	0		
BOF		BOP	01-21-2-L	CREW SR (2)	15.6	0	0		
BOF		BOP	01-28-2-L	CREW SR (3)	10.4	0	0		
BOF		BOP	01-28-2-L	CREW SR (3)	15.9	-99	-56	DJ	NC
BOF		BOP	01-28-2-L	CREW SR (3)	24.7	0	0		
D06			1A-14-0-Q	MAIN DECK UTILITY SP	36.6	0	0		
DOF			01A-14-2-Q	FCSLE DECK UTILITY S	36.6	0	0		
			01-27-1-L	**T/S**	**(CUI = LW)**				
BOF		BOP	01-24-1-L	CREW SR (2)	15.9	-99	-56	DJ	NC
BOF		BOP	01-24-1-L	CREW SR (2)	27.3	0	0		
BOF		BOP	01-24-1-L	CREW SR (2)	23.4	0	0		
BOF		BOP	01-30-1-L	CREW SR (2)	17.5	-99	-56	DJ	NC
BOF		BOP	01-30-1-L	CREW SR (2)	28.6	0	0		
BOF	B06		(none)	(weather bulkhead)	44.2	0	0		
D06			1A-14-0-Q	MAIN DECK UTILITY SP	39.6	0	0		
DOF			01A-14-1-Q	FCSLE DECK UTILITY S	39.6	0	0		
			01-28-2-L	**CREW SR (3)**	**(CUI = L5)**				
BOP		BOP	01-10-0A-L	PASSAGE	62.4	-99	-56	DJ	NC
BOP		BOP	01-21-2-L	CREW SR (2)	45.5	0	0		
BOP		BOF	01-26-2-L	T/S	10.4	0	0		
BOP		BOF	01-26-2-L	T/S	15.9	-99	-56	DJ	NC
BOP		BOF	01-26-2-L	T/S	24.7	0	0		
BOP	B05	BOP	01-34-2-L	CREW SR (3)	74.1	0	0		
BOP		B05	01-34-2A-T	VENT TRUNK	10.4	0	0		
BOP	B06		(none)	(weather bulkhead)	81.9	0	0	DJ	NC
D06			1A-14-0-Q	MAIN DECK UTILITY SP	146.5	0	0		
DOC			01A-14-2-Q	FCSLE DECK UTILITY S	146.5	0	0		
			01-30-1-L	**CREW SR (2)**	**(CUI = L2)**				
BOP		BOP	01-10-0A-L	PASSAGE	26.0	0	0		
BOP		BOP	01-10-0A-L	PASSAGE	26.7	-99	-56	DJ	NC
BOP		BOP	01-10-0A-L	PASSAGE	11.7	0	0		
BOP		B05	01-10-0A-L	PASSAGE	32.5	-99	-56	DJ	NC
BOP		B05	01-10-0B-L	PASSAGE	16.9	0	0		
BOP		BOP	01-24-1-L	CREW SR (2)	29.9	0	0		
BOP		BOF	01-27-1-L	T/S	17.5	-99	-56	DJ	NC
BOP		BOF	01-27-1-L	T/S	28.6	0	0		
BOP	B05	BOF	01-34-1-L	T/S	41.6	0	0		
BOP	B05	BOP	01-34-3-L	CREW SR (3)	59.8	0	0		
BOP	B06		(none)	(weather bulkhead)	50.7	0	0	DJ	NC
D06			1A-14-0-Q	MAIN DECK UTILITY SP	135.9	0	0		
DOC			01A-14-1-Q	FCSLE DECK UTILITY S	135.9	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-34-1-L	**T/S**	**(CUI = LW)**				
BOF		B05	01-10-0B-L	PASSAGE	26.0	0	0		
BOF	B05	BOP	01-30-1-L	CREW SR (2)	41.6	0	0		
BOF		BOP	01-34-3-L	CREW SR (3)	7.8	0	0		
BOF		BOP	01-34-3-L	CREW SR (3)	16.3	-99	-56	DJ	NC
BOF		BOP	01-34-3-L	CREW SR (3)	27.3	-99	-56	DJ	NC
BOF		BOP	01-34-3-L	CREW SR (3)	41.6	0	0		
D06			1A-34-1-Q	MAIN DECK UTILITY SP	39.6	0	0		
DOF			01A-34-1-Q	FCSLE DECK UTILITY S	39.6	0	0		
			01-34-2-L	**CREW SR (3)**	**(CUI = L5)**				
BOP		B06	1-40-4-T	UPTAKE	36.4	0	0		
BOP		B06	1-40-4-T	UPTAKE	23.4	0	0		
BOP		BOP	01-10-0B-L	PASSAGE	52.0	-99	-56	DJ	NC
BOP		BOP	01-10-0B-L	PASSAGE	10.4	0	0		
BOP	B05	BOP	01-28-2-L	CREW SR (3)	74.1	0	0		
BOP		B05	01-34-2A-T	VENT TRUNK	10.4	0	0		
BOP		B05	01-34-2A-T	VENT TRUNK	39.0	0	0		
BOP		BOF	01-41-2-L	T/S	14.8	-99	-56	DJ	NC
BOP		BOF	01-41-2-L	T/S	26.0	-99	-56	DJ	NC
BOP	B06		(none)	(weather bulkhead)	76.7	0	0	DJ	NC
D06			1-34-2-Q	FAN ROOM	145.3	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	16.1	0	0		
DOC			01A-34-0-Q	FCSLE DECK UTILITY S	161.3	0	0		
			01-34-2A-T	**VENT TRUNK**	**(CUI = TH)**				
B05		BOP	01-10-0B-L	PASSAGE	39.0	0	0		
B05		BOP	01-28-2-L	CREW SR (3)	10.4	0	0		
B05		BOP	01-34-2-L	CREW SR (3)	10.4	0	0		
B05		BOP	01-34-2-L	CREW SR (3)	39.0	0	0		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	3.2	0	0		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	12.0	0	0		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	3.2	0	0		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	12.0	0	0		
B05		BOP	02-20-0-L	PASSAGE	45.0	0	0		
B05		BOP	02-30-2-L	OFFICERS SR (2)	34.5	0	0		
B05		BOP	02-32-2-Q	HW HTR LKR	10.5	0	0		
B05		BOP	02-37-2-L	FIRST LT. SR (2)	10.5	0	0		
B05		BOP	02-37-2-L	FIRST LT. SR (2)	10.5	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	12.0	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	2.8	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	12.0	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	2.8	0	0		
D00			1-34-2-Q	FAN ROOM	9.6	0	0		
D06			(none)	(weather overhead)	8.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-34-3-L	**CREW SR (3)**	**(CUI = L5)**				
BOP		B06	1-40-1-T	UPTAKE	36.4	0	0		
BOP		B05	01-10-0B-L	PASSAGE	16.9	0	0		
BOP		B05	01-10-0B-L	PASSAGE	50.7	-99	-56	DJ	NC
BOP	B05	BOP	01-30-1-L	CREW SR (2)	59.8	0	0		
BOP		BOF	01-34-1-L	T/S	7.8	0	0		
BOP		BOF	01-34-1-L	T/S	16.3	-99	-56	DJ	NC
BOP		BOF	01-34-1-L	T/S	27.3	-99	-56		
BOP		BOF	01-34-1-L	T/S	41.6	0	0		
BOP		BOP	01-40-1-A	SPONSOR STRM	81.9	0	0		
BOP	B06		(none)	(weather bulkhead)	76.7	0	0		
D06			1A-34-1-Q	MAIN DECK UTILITY SP	164.7	0	0		
DOC			01A-34-1-Q	FCSLE DECK UTILITY S	164.7	0	0		
			01-40-1-A	**SPONSOR STRM**	**(CUI = AS)**				
BOP		B06	1-40-1-T	UPTAKE	49.4	0	0		
BOP		BOP	01-10-0B-L	PASSAGE	81.9	0	0		
BOP		B05	01-10-0B-L	PASSAGE	49.4	-99	-56	DJ	NC
BOP		BOP	01-34-3-L	CREW SR (3)	81.9	0	0		
D06			1A-34-1-Q	MAIN DECK UTILITY SP	69.3	0	0		
D06			1A-42-1-Q	MAIN DECK UTILITY SP	26.4	0	0		
D04			01A-34-1-Q	FCSLE DECK UTILITY S	95.8	0	0		
			01-41-2-L	**T/S**	**(CUI = LW)**				
BOF		B06	1-40-4-T	UPTAKE	26.0	0	0		
BOF		BOP	01-10-0B-L	PASSAGE	42.9	0	0		
BOF		BOP	01-34-2-L	CREW SR (3)	14.8	-99	-56	DJ	NC
BOF		BOP	01-34-2-L	CREW SR (3)	26.0	-99	-56		
BOF		BOP	01-44-2-L	CREW SR (3)	14.1	-99	-56	DJ	NC
BOF		BOP	01-44-2-L	CREW SR (3)	26.0	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	35.9	0	0		
DOF			01A-34-0-Q	FCSLE DECK UTILITY S	35.9	0	0		
			01-44-2-L	**CREW SR (3)**	**(CUI = L5)**				
BOP		B06	1-40-4-T	UPTAKE	23.4	0	0		
BOP		B06	1-40-4-T	UPTAKE	16.9	0	0		
BOP		BOP	01-10-0B-L	PASSAGE	10.4	0	0		
BOP		BOP	01-10-0B-L	PASSAGE	94.9	-99	-56	DJ	NC
BOP		BOP	01-10-0B-L	PASSAGE	71.5	0	0		
BOP		BOF	01-41-2-L	T/S	14.1	-99	-56	DJ	NC
BOP		BOF	01-41-2-L	T/S	26.0	0	0		
BOP	B06		(none)	(weather bulkhead)	85.8	0	0	DJ	NC
D06			1A-34-2-Q	MAIN DECK UTILITY SP	156.6	0	0		
DOC			01A-34-0-Q	FCSLE DECK UTILITY S	156.6	0	0		
			01-46-1-L	**T/S**	**(CUI = LW)**				
BOF		B06	1-46-1-T	MCHRY ACCESS & REMOV	57.2	0	0		
BOF		BOP	01-10-0B-L	PASSAGE	18.2	0	0		
BOF		BOP	01-10-0B-L	PASSAGE	10.2	0	0		
BOF		BOP	01-10-0B-L	PASSAGE	11.7	0	0		
BOF		BOP	01-47-1-L	CREW SR (3)	24.7	0	0		
BOF		BOP	01-47-1-L	CREW SR (3)	37.7	-99	-56	DJ	NC
D06			1A-42-1-Q	MAIN DECK UTILITY SP	32.8	0	0		
DOF			01A-34-1-Q	FCSLE DECK UTILITY S	32.8	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-47-1-L	**CREW SR (3)**	**(CUI = L5)**				
BOP		B06	1-46-1-T	MCHRY ACCESS & REMOV	42.9	0	0		
BOP		B06	1-46-1-T	MCHRY ACCESS & REMOV	22.1	0	0		
BOP		BOP	01-10-0B-L	PASSAGE	36.4	0	0		
BOP		B05	01-10-0B-L	PASSAGE	31.2	-99	-56	DJ	NC
BOP		BOF	01-46-1-L	T/S	24.7	0	0		
BOP		BOF	01-46-1-L	T/S	37.7	-99	-56	DJ	NC
BOP	B05	BOP	01-54-1-C	COMMUNICATION CTR	104.0	0	0		
BOP	B06		(none)	(weather bulkhead)	91.0	0	0	DJ	NC
D06			1-46-1-T	MCHRY ACCESS & REMOV	5.3	0	0		
D06			1A-42-1-Q	MAIN DECK UTILITY SP	72.0	0	0		
D06			1A-52-1-Q	MAIN DECK UTILITY SP	64.0	0	0		
DOC			01A-34-1-Q	FCSLE DECK UTILITY S	141.2	0	0		
			01-54-1-C	**COMMUNICATION CTR**	**(CUI = C)**				
BOP	B05	BOP	01-47-1-L	CREW SR (3)	104.0	0	0		
BOP		B05	01-54-2-L	VESTIBULE	79.3	-30	-8	DJ	NC
BOP	B05	BOP	01-61-0-L	TRAINING RM/ CREWS L	100.1	0	0		
BOP	B06		(none)	(weather bulkhead)	79.3	0	0	DJ	NC
BOP	B06		(none)	(weather bulkhead)	3.9	0	0		
D06			1A-52-1-Q	MAIN DECK UTILITY SP	195.2	0	0		
D04			01A-54-1-Q	FCSLE DECK UTILITY S	195.2	0	0		
			01-54-2-L	**VESTIBULE**	**(CUI = LP)**				
B05		B05	01-10-0B-L	PASSAGE	32.5	0	0	DJ	NC
B05		BOP	01-54-1-C	COMMUNICATION CTR	79.3	-30	-8	DJ	NC
B05		B05	01-54-4-A	CG LKR	33.8	0	0		
B05		BOP	01-57-2-L	PASSENGER BERTHING (	45.5	0	0		
B05		BOP	01-61-0-L	TRAINING RM/ CREWS L	7.8	0	0		
B05		B05	01-61-2-L	PASSAGE	24.7	-30	-8	DJ	NC
D06			1A-34-2-Q	MAIN DECK UTILITY SP	61.0	0	0		
DOC			01A-54-2-Q	FCSLE DECK UTILITY S	61.0	0	0		
			01-54-4-A	**CG LKR**	**(CUI = AG)**				
B05		B05	01-10-0B-L	PASSAGE	32.5	-30	-8	DJ	NC
B05		B05	01-54-2-L	VESTIBULE	33.8	0	0		
BOP		BOF	01-54-6-L	T/S	33.8	0	0		
B05		BOP	01-57-2-L	PASSENGER BERTHING (	32.5	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	26.0	0	0		
DOC			01A-54-2-Q	FCSLE DECK UTILITY S	26.0	0	0		
			01-54-6-L	**T/S**	**(CUI = LW)**				
BOF		B05	01-10-0B-L	PASSAGE	39.0	0	0		
BOF		BOP	01-54-4-A	CG LKR	33.8	0	0		
BOF		BOP	01-57-2-L	PASSENGER BERTHING (	55.9	-99	-56	DJ	NC
BOF	B06		(none)	(weather bulkhead)	33.8	0	0		
BOF	B06		(none)	(weather bulkhead)	16.9	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	44.7	0	0		
DOF			01A-54-2-Q	FCSLE DECK UTILITY S	44.7	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-57-2-L	**PASSENGER BERTHING (6)**	**(CUI = L5)**				
BOP		B05	01-54-2-L	VESTIBULE	45.5	0	0		
BOP		B05	01-54-4-A	CG LKR	32.5	0	0		
BOP		BOF	01-54-6-L	T/S	55.9	-99	-56	DJ	NC
BOP		BOP	01-61-2-L	PASSAGE	50.7	-99	-56	DJ	NC
BOP		BOP	01-64-2-K	ARMORY/LAW ENFORCEME	88.4	0	0		
BOP	B06		(none)	(weather bulkhead)	96.2	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	201.3	0	0		
DOC			01A-54-2-Q	FCSLE DECK UTILITY S	201.3	0	0		
			01-61-0-L	**TRAINING RM/ CREWS LOUNGE**	**(CUI = LL)**				
BOP	B05	BOP	01-54-1-C	COMMUNICATION CTR	100.1	0	0		
BOP		B05	01-54-2-L	VESTIBULE	7.8	0	0		
BOP		B05	01-61-2-L	PASSAGE	104.0	-99	-56	DJ	NC
BOP		B06	01-68-0-Q	ELECTRONICS & ELECTR	62.4	0	0		
BOP		B06	01-69-1-Q	HYD. POWER RM.	45.5	0	0	DWT	Z
BOP	B06		(none)	(weather bulkhead)	106.6	0	0	DWT	Z
D06			1-62-1-A	DC LKR	17.3	0	0		
D06			1-62-3-Q	GENERAL WORKSHOP	148.8	0	0		
D06			1-68-1-L	STWY	5.8	0	0		
D06			1-68-3-Q	FAN ROOM	21.7	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	19.2	0	0		
D06			1A-52-1-Q	MAIN DECK UTILITY SP	55.6	0	0		
DOC			01A-54-1-Q	FCSLE DECK UTILITY S	268.4	0	0		
			01-61-2-L	**PASSAGE**	**(CUI = LP)**				
B05		B05	01-54-2-L	VESTIBULE	24.7	-30	-8	DJ	NC
BOP		BOP	01-57-2-L	PASSENGER BERTHING (	50.7	-99	-56	DJ	NC
B05		BOP	01-61-0-L	TRAINING RM/ CREWS L	104.0	-99	-56	DJ	NC
BOP		BOP	01-64-2-K	ARMORY/LAW ENFORCEME	53.3	-99	-56	DJ	NC
B05		B06	01-68-0-Q	ELECTRONICS & ELECTR	24.7	0	0	DWT	Z
D06			1A-34-2-Q	MAIN DECK UTILITY SP	60.8	0	0		
DOC			01A-54-2-Q	FCSLE DECK UTILITY S	60.8	0	0		
			01-64-2-K	**ARMORY/LAW ENFORCEMENT CENTER**	**(CUI = K)**				
BOP		BOP	01-57-2-L	PASSENGER BERTHING (	88.4	0	0		
BOP		BOP	01-61-2-L	PASSAGE	53.3	-99	-56	DJ	NC
BOP		B06	01-68-0-Q	ELECTRONICS & ELECTR	88.4	0	0		
BOP	B06		(none)	(weather bulkhead)	53.3	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	111.5	0	0		
DOC			01A-54-2-Q	FCSLE DECK UTILITY S	111.5	0	0		
			01-68-0-Q	**ELECTRON. & ELECTRICAL SHOP**	**(CUI = QS)**				
B06		BOP	01-61-0-L	TRAINING RM/ CREWS L	62.4	0	0		
B06		B05	01-61-2-L	PASSAGE	24.7	0	0	DWT	Z
B06		BOP	01-64-2-K	ARMORY/LAW ENFORCEME	88.4	0	0		
B05		B06	01-69-1-Q	HYD. POWER RM.	78.2	0	0		
B06		B06	01A-54-1-Q	FCSLE DECK UTILITY S	19.2	0	0		
B06		B06	01A-54-2-Q	FCSLE DECK UTILITY S	34.8	0	0		
B05	B06		(none)	(weather bulkhead)	81.6	0	0		
B05	B06		(none)	(weather bulkhead)	229.5	0	0	DWT	Z
D06			1-68-1-L	STWY	28.1	0	0		
D06			1-68-3-Q	FAN ROOM	37.4	0	0		
D06			1A-34-2-Q	MAIN DECK UTILITY SP	145.1	0	0		
D06			(none)	(weather overhead)	259.2	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01-69-1-Q	**HYD. POWER RM.**	**(CUI = QA)**				
B06		BOP	01-61-0-L	TRAINING RM/ CREWS L	45.5	0	0	DWT	Z
B06		B05	01-68-0-Q	ELECTRONICS & ELECTR	78.2	0	0		
B06		B06	01A-54-1-Q	FCSLE DECK UTILITY S	14.0	0	0		
B06	B06		(none)	(weather bulkhead)	59.5	-10	-10		
B05	B06		(none)	(weather bulkhead)	78.2	0	0		
D06			1-68-3-Q	FAN ROOM	51.8	0	0		
D06			(none)	(weather overhead)	64.4	0	0		
			01A-14-1-Q	**FCSLE DECK UTILITY SPACE NO.1**	**(CUI = QF)**				
B05		B05	01-22-1-L	STAIRWAY	8.0	0	0		
B05		B05	01-22-1-L	STAIRWAY	28.8	0	0		
B06		BOP	01-22-1-L	STAIRWAY	8.0	0	0		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	19.2	-5	-5		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	32.0	-5	-5		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	5.2	0	0		
B05		B05	01A-34-1-Q	FCSLE DECK UTILITY S	31.2	0	0		
B05		B05	01-10-0-L	PASSAGE	8.0	0	0		
B05	B06		(none)	(weather bulkhead)	15.6	0	0		
B05	B06		(none)	(weather bulkhead)	13.6	0	0		
B05	B06		(none)	(weather bulkhead)	12.4	0	0		
B05	B06		(none)	(weather bulkhead)	18.9	0	0		
B05	B06		(none)	(weather bulkhead)	19.9	0	0		
B05	B06		(none)	(weather bulkhead)	0.0	0	0		
DOC			01-10-0A-L	PASSAGE	28.0	0	0		
DOC			01-14-1-L	CREW SR (2)	131.0	0	0		
DOF			01-17-1-L	T/S	38.1	0	0		
DOC			01-19-1-L	CREW SR (2)	129.8	0	0		
DOC			01-24-1-L	CREW SR (2)	123.7	0	0		
DOF			01-27-1-L	T/S	39.6	0	0		
DOC			01-30-1-L	CREW SR (2)	135.9	0	0		
D06			02-14-1-L	T/S	36.4	0	0		
D06			02-14-3-L	CO SR	152.9	0	0		
D06			02-20-0-L	PASSAGE	92.4	0	0		
D06			02-22-1-Q	SHIP'S OFFICE & SUPP	195.4	0	0		
D06			02-30-1-L	OFFICERS SR (2)	125.8	0	0		
D06			02-33-1-L	T/S	20.1	0	0		
D06			(none)	(weather overhead)	3.2	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft^2	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01A-14-2-Q	**FCSLE DECK UTILITY SPACE NO.2**	**(CUI = QF)**				
B05		B05	01-22-1-L	STAIRWAY	28.8	-5	-5		
B05		B05	01-34-2A-T	VENT TRUNK	3.2	0	0		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	19.2	-5	-5		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	32.0	-5	-5		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	22.8	0	0		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	10.0	0	0		
B05		B05	01-10-0-L	PASSAGE	12.0	0	0		
B05	B06		(none)	(weather bulkhead)	29.1	0	0		
B05	B06		(none)	(weather bulkhead)	26.1	0	0		
B05	B06		(none)	(weather bulkhead)	25.2	0	0		
B05	B06		(none)	(weather bulkhead)	0.0	0	0		
DOC			01-10-0A-L	PASSAGE	200.0	0	0		
DOF			01-14-2-L	T/S	39.7	0	0		
DOC			01-14-4-L	CREW SR (2)	114.4	0	0		
DOC			01-21-2-L	CREW SR (2)	139.3	0	0		
DOF			01-26-2-L	T/S	36.6	0	0		
DOC			01-28-2-L	CREW SR (3)	146.5	0	0		
D06			02-14-2-L	EO SR	153.3	0	0		
D06			02-18-2-L	T/S	32.9	0	0		
D06			02-20-0-L	PASSAGE	193.6	0	0		
D06			02-22-2-L	XO SR	130.0	0	0		
D06			02-27-2-L	T/S	33.5	0	0		
D06			02-30-2-L	OFFICERS SR (2)	114.5	0	0		
D06			02-32-2-Q	HW HTR LKR	8.6	0	0		
D06			02-33-2-L	T/S	9.7	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	(CUI = QF)				
B05		B06	1-40-1-T	UPTAKE	11.2	0	0		
B06		B06	1-40-1-T	UPTAKE	6.8	0	0		
B05		B06	1-40-1-T	UPTAKE	20.4	0	0		
B06		B05	1-46-1-T	MCHRY ACCESS & REMOV	13.2	0	0		
B06		B05	1-46-1-T	MCHRY ACCESS & REMOV	24.4	0	0		
B06		B05	1-46-1-T	MCHRY ACCESS & REMOV	13.2	0	0		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	31.2	0	0		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	9.6	-5	-5		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	38.0	-5	-5		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	5.2	0	0		
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	8.0	0	0		
B05		B05	01A-54-1-Q	FCSLE DECK UTILITY S	32.0	0	0		
B05	B06		(none)	(weather bulkhead)	36.0	0	0		
B05	B06		(none)	(weather bulkhead)	23.6	0	0		
DOC			01-10-0B-L	PASSAGE	66.2	0	0		
DOF			01-34-1-L	T/S	39.6	0	0		
DOC			01-34-3-L	CREW SR (3)	164.7	0	0		
D04			01-40-1-A	SPONSOR STRM	95.8	0	0		
DOF			01-46-1-L	T/S	32.8	0	0		
DOC			01-47-1-L	CREW SR (3)	141.2	0	0		
D06			02-20-0-L	PASSAGE	41.6	0	0		
D06			02-30-1-L	OFFICERS SR (2)	21.6	0	0		
D06			02-33-1-L	T/S	14.9	0	0		
D06			02-35-1-L	OPS. OFF. SR (2)	141.4	0	0		
D06			02-36-1-L	T/S	43.4	0	0		
D06			02-42-1-Q	FAN RM	60.0	0	0		
D06			(none)	(weather overhead)	217.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01A-34-0-Q	**FCSLE DECK UTILITY SPACE NO.4**	**(CUI = QF)**				
B06		B06	1-40-4-T	UPTAKE	11.2	0	0		
B05		B06	1-40-4-T	UPTAKE	20.4	0	0		
B05		B06	1-40-4-T	UPTAKE	7.2	0	0		
B06		B05	1-46-1-T	MCHRY ACCESS & REMOV	24.4	-5	-5		
B05		B05	01-34-2A-T	VENT TRUNK	12.0	0	0		
B05		B05	01-34-2A-T	VENT TRUNK	3.2	0	0		
B05		B05	01-34-2A-T	VENT TRUNK	12.0	0	0		
B05		B05	01A-14-1-Q	FCSLE DECK UTILITY S	5.2	0	0		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	22.8	0	0		
B05		B05	01A-14-2-Q	FCSLE DECK UTILITY S	10.0	0	0		
B05		B05	01A-34-1-Q	FCSLE DECK UTILITY S	9.6	-5	-5		
B05		B05	01A-34-1-Q	FCSLE DECK UTILITY S	38.0	-5	-5		
B05		B05	01A-34-1-Q	FCSLE DECK UTILITY S	5.2	0	0		
B05		B05	01A-34-1-Q	FCSLE DECK UTILITY S	8.0	0	0		
B05		B05	01A-54-2-Q	FCSLE DECK UTILITY S	32.0	0	0		
B05	B06		(none)	(weather bulkhead)	23.6	0	0		
B05	B06		(none)	(weather bulkhead)	36.0	0	0		
DOC			01-10-0B-L	PASSAGE	273.8	0	0		
DOC			01-34-2-L	CREW SR (3)	161.3	0	0		
DOF			01-41-2-L	T/S	35.9	0	0		
DOC			01-44-2-L	CREW SR (3)	156.6	0	0		
D06			02-20-0-L	PASSAGE	62.4	0	0		
D06			02-30-2-L	OFFICERS SR (2)	25.5	0	0		
D06			02-33-2-L	T/S	29.0	0	0		
D06			02-37-2-L	FIRST LT. SR (2)	134.6	0	0		
D06			02-41-2-L	T/S	40.4	0	0		
D06			02-42-2-A	CG LKR	14.7	0	0		
D06			(none)	(weather overhead)	312.8	0	0		
			01A-54-1-Q	**FCSLE DECK UTILITY SPACE NO.5**	**(CUI = QF)**				
B05		B05	01A-34-1-Q	FCSLE DECK UTILITY S	32.0	0	0		
B05		B05	01A-54-2-Q	FCSLE DECK UTILITY S	24.4	0	0		
B05		B05	01A-54-2-Q	FCSLE DECK UTILITY S	2.4	0	0		
B05		B05	01A-54-2-Q	FCSLE DECK UTILITY S	32.0	0	0		
B06		B06	01-68-0-Q	ELECTRONICS & ELECTR	19.2	0	0		
B06		B06	01-69-1-Q	HYD. POWER RM.	14.0	0	0		
B05	B06		(none)	(weather bulkhead)	0.0	0	0		
B05	B06		(none)	(weather bulkhead)	0.0	0	0		
B05	B06		(none)	(weather bulkhead)	32.8	0	0		
B05	B06		(none)	(weather bulkhead)	1.2	0	0		
B05	B06		(none)	(weather bulkhead)	24.4	0	0		
D04			01-54-1-C	COMMUNICATION CTR	195.2	0	0		
DOC			01-61-0-L	TRAINING RM/ CREWS L	268.4	0	0		
D06			(none)	(weather overhead)	463.6	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			01A-54-2-Q	**FCSLE DECK UTILITY SPACE NO.6**	**(CUI = QF)**				
B05		B05	01A-34-0-Q	FCSLE DECK UTILITY S	32.0	0	0		
B05		B05	01A-54-1-Q	FCSLE DECK UTILITY S	24.4	0	0		
B05		B05	01A-54-1-Q	FCSLE DECK UTILITY S	2.4	0	0		
B05		B05	01A-54-1-Q	FCSLE DECK UTILITY S	32.0	0	0		
B06		B06	01-68-0-Q	ELECTRONICS & ELECTR	34.8	0	0		
B05	B06		(none)	(weather bulkhead)	56.4	0	0		
B05	B06		(none)	(weather bulkhead)	0.0	0	0		
B05	B06		(none)	(weather bulkhead)	5.2	0	0		
DOC			01-54-2-L	VESTIBULE	61.0	0	0		
DOC			01-54-4-A	CG LKR	26.0	0	0		
DOF			01-54-6-L	T/S	44.7	0	0		
DOC			01-57-2-L	PASSENGER BERTHING	201.3	0	0		
DOC			01-61-2-L	PASSAGE	60.8	0	0		
DOC			01-64-2-K	ARMORY/LAW ENFORCEME	111.5	0	0		
D06			(none)	(weather overhead)	505.3	0	0		
			02-14-1-L	**T/S**	**(CUI = LW)**				
BOF		BOP	02-14-2-L	EO SR	31.5	0	0		
BOF		BOP	02-14-3-L	CO SR	58.5	-99	-56	DJ	NC
BOF		BOP	02-14-3-L	CO SR	11.7	0	0		
BOF		BOP	02-14-3-L	CO SR	22.5	0	0		
BOF	B06		(none)	(weather bulkhead)	66.0	0	0		
D06			01A-14-1-Q	FCSLE DECK UTILITY S	36.4	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	36.4	0	0		
			02-14-2-L	**EO SR**	**(CUI = L1)**				
BOP		BOF	02-14-1-L	T/S	31.5	0	0		
BOP		BOP	02-14-3-L	CO SR	30.0	0	0		
BOP		BOF	02-18-2-L	T/S	10.6	0	0		
BOP		BOF	02-18-2-L	T/S	58.5	-99	-56	DJ	NC
BOP		BOF	02-18-2-L	T/S	21.0	0	0		
BOP		BOP	02-20-0-L	PASSAGE	66.0	-99	-56	DJ	NC
BOP	B06		(none)	(weather bulkhead)	90.1	0	0	DJ	NC
BOP	B06		(none)	(weather bulkhead)	127.5	0	0	DJ	NC
D06			01A-14-2-Q	FCSLE DECK UTILITY S	153.3	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	174.7	0	0		
			02-14-3-L	**CO SR**	**(CUI = L1)**				
BOP		BOF	02-14-1-L	T/S	58.5	-99	-56	DJ	NC
BOP		BOF	02-14-1-L	T/S	11.7	0	0		
BOP		BOF	02-14-1-L	T/S	22.5	0	0		
BOP		BOP	02-14-2-L	EO SR	30.0	0	0		
BOP		BOF	02-18-2-L	T/S	28.5	0	0		
BOP		BOP	02-20-0-L	PASSAGE	132.0	-99	-56	DJ	NC
BOP	B06		(none)	(weather bulkhead)	90.1	0	0	DJ	NC
BOP	B06		(none)	(weather bulkhead)	61.5	0	0	DJ	NC
D06			01A-14-1-Q	FCSLE DECK UTILITY S	152.9	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	171.2	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			02-18-2-L	**T/S**	**(CUI = LW)**				
BOF		BOP	02-14-2-L	EO SR	10.6	0	0		
BOF		BOP	02-14-2-L	EO SR	58.5	-99	-56	DJ	NC
BOF		BOP	02-14-2-L	EO SR	21.0	0	0		
BOF		BOP	02-14-3-L	CO SR	28.5	0	0		
BOF		BOP	02-20-0-L	PASSAGE	66.0	0	0		
D06			01A-14-2-Q	FCSLE DECK UTILITY S	32.9	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	32.9	0	0		
			02-20-0-L	**PASSAGE**	**(CUI = LP)**				
B05		B05	01-22-1-L	STAIRWAY	18.0	0	0		
B05		B05	01-22-1-L	STAIRWAY	32.4	0	0	DWT	Z
BOP		B05	01-34-2A-T	VENT TRUNK	45.0	0	0		
BOP		BOP	02-14-2-L	EO SR	66.0	-99	-56	DJ	NC
BOP		BOP	02-14-3-L	CO SR	132.0	-99	-56	DJ	NC
BOP		BOF	02-18-2-L	T/S	66.0	0	0		
B05		BOP	02-22-1-Q	SHIP'S OFFICE & SUPP	102.0	-30	-8	DJ	NC
BOP		BOP	02-22-2-L	XO SR	45.0	0	0		
BOP		BOP	02-22-2-L	XO SR	18.0	0	0		
BOP		BOP	02-22-2-L	XO SR	49.5	0	0		
BOP		BOP	02-22-2-L	XO SR	48.0	-99	-56	DJ	NC
B05		B05	02-25-1-L	STAIRWAY	19.5	0	0		
B05		B05	02-25-1-L	STAIRWAY	54.0	0	0	DWT	Z
B05		B05	02-25-1-L	STAIRWAY	12.0	0	0		
B05		B05	02-25-1-L	STAIRWAY	21.6	0	0		
BOP		BOF	02-27-2-L	T/S	42.0	0	0		
BOP		BOP	02-30-1-L	OFFICERS SR (2)	46.5	-99	-56	DJ	NC
BOP		BOP	02-30-2-L	OFFICERS SR (2)	43.5	-99	-56	DJ	NC
BOP		BOP	02-32-2-Q	HW HTR LKR	18.0	-30	-8	DJ	NC
BOP		BOP	02-32-2-Q	HW HTR LKR	27.0	0	0		
BOP		BOF	02-33-1-L	T/S	43.5	0	0		
BOP		BOP	02-35-1-L	OPS. OFF. SR (2)	48.0	-99	-56	DJ	NC
BOP		BOF	02-36-1-L	T/S	54.0	0	0		
BOP		BOP	02-37-2-L	FIRST LT. SR (2)	72.0	-99	-56	DJ	NC
B05		B06	02-42-1-Q	FAN RM	30.0	0	0	DWT	X
BOP		BOP	02-42-2-A	CG LKR	34.5	-30	-8	DJ	NC
BOP	B06		(none)	(weather bulkhead)	30.0	0	0	DWT	Z
BOP	B06		(none)	(weather bulkhead)	39.0	0	0	DWT	Z
BOP	B06		(none)	(weather bulkhead)	30.0	0	0	DWT	Z
D06			01A-14-1-Q	FCSLE DECK UTILITY S	92.4	0	0		
D06			01A-14-2-Q	FCSLE DECK UTILITY S	193.6	0	0		
D06			01A-34-0-Q	FCSLE DECK UTILITY S	62.4	0	0		
D06			01A-34-1-Q	FCSLE DECK UTILITY S	41.6	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	396.5	0	0		
			02-22-1-Q	**SHIP'S OFFICE & SUPPLY OFFICE**	**(CUI = QO)**				
BOP		B05	01-22-1-L	STAIRWAY	32.4	0	0		
BOP		B05	02-20-0-L	PASSAGE	102.0	-30	-8	DJ	NC
BOP		B05	02-25-1-L	STAIRWAY	54.0	0	0		
BOP		B05	02-25-1-L	STAIRWAY	21.6	0	0		
BOP	B05	BOP	02-30-1-L	OFFICERS SR (2)	103.5	0	0		
BOP	B06		(none)	(weather bulkhead)	108.0	0	0	DJ	NC
D06			01A-14-1-Q	FCSLE DECK UTILITY S	195.4	0	0		
DOC			02A-22-1-Q	UPPER DECK UTILITY S	197.3	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			02-22-2-L	**XO SR**	**(CUI = L1)**				
BOP		BOP	02-20-0-L	PASSAGE	45.0	0	0		
BOP		BOP	02-20-0-L	PASSAGE	18.0	0	0		
BOP		BOP	02-20-0-L	PASSAGE	49.5	0	0		
BOP		BOP	02-20-0-L	PASSAGE	48.0	-99	-56	DJ	NC
BOP		BOF	02-27-2-L	T/S	17.5	-99	-56	DJ	NC
BOP		BOF	02-27-2-L	T/S	37.5	0	0		
BOP		BOF	02-27-2-L	T/S	27.0	0	0		
BOP		BOP	02-30-2-L	OFFICERS SR (2)	51.0	0	0		
BOP	B06		(none)	(weather bulkhead)	108.0	0	0	DJ	NC
D06			01A-14-2-Q	FCSLE DECK UTILITY S	130.0	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	135.0	0	0		
			02-25-1-L	**STAIRWAY**	**(CUI = LP)**				
B05		B05	01-22-1-L	STAIRWAY	18.0	0	0		
B05		B05	02-20-0-L	PASSAGE	19.5	0	0		
B05		B05	02-20-0-L	PASSAGE	54.0	0	0	DWT	Z
B05		B05	02-20-0-L	PASSAGE	12.0	0	0		
B05		B05	02-20-0-L	PASSAGE	21.6	0	0		
B05		BOP	02-22-1-Q	SHIP'S OFFICE & SUPP	54.0	0	0		
B05		BOP	02-22-1-Q	SHIP'S OFFICE & SUPP	21.6	0	0		
B05		BOP	02-30-1-L	OFFICERS SR (2)	10.5	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	8.0	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	8.0	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	28.8	0	0		
B05		B05	02A-22-1-Q	UPPER DECK UTILITY S	28.8	0	0		
D06			01-22-1-L	STAIRWAY	28.8	0	0		
D04			01-22-1-L	STAIRWAY	28.8	0	0		
D00			03-15-0-C	PILOT HOUSE	48.0	0	0		
D06			(none)	(weather overhead)	9.6	0	0		
			02-27-2-L	**T/S**	**(CUI = LW)**				
BOF		BOP	02-20-0-L	PASSAGE	42.0	0	0		
BOF		BOP	02-22-2-L	XO SR	17.5	-99	-56	DJ	NC
BOF		BOP	02-22-2-L	XO SR	37.5	0	0		
BOF		BOP	02-22-2-L	XO SR	27.0	0	0		
BOF		BOP	02-30-2-L	OFFICERS SR (2)	46.5	0	0		
D06			01A-14-2-Q	FCSLE DECK UTILITY S	33.5	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	33.5	0	0		
			02-30-1-L	**OFFICERS SR (2)**	**(CUI = L2)**				
BOP		BOP	02-20-0-L	PASSAGE	46.5	-99	-56	DJ	NC
BOP	B05	BOP	02-22-1-Q	SHIP'S OFFICE & SUPP	103.5	0	0		
BOP		B05	02-25-1-L	STAIRWAY	10.5	0	0		
BOP		BOF	02-33-1-L	T/S	34.5	0	0		
BOP		BOF	02-33-1-L	T/S	15.0	-99	-56	DJ	NC
BOP		BOF	02-33-1-L	T/S	34.5	0	0		
BOP		BOP	02-35-1-L	OPS. OFF. SR (2)	67.5	0	0		
BOP	B06		(none)	(weather bulkhead)	90.0	0	0	DJ	NC
D06			01A-14-1-Q	FCSLE DECK UTILITY S	125.8	0	0		
D06			01A-34-1-Q	FCSLE DECK UTILITY S	21.6	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	147.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			02-30-2-L	**OFFICERS SR (2)**	**(CUI = L2)**				
BOP		B05	01-34-2A-T	VENT TRUNK	34.5	0	0		
BOP		BOP	02-20-0-L	PASSAGE	43.5	-99	-56	DJ	NC
BOP		BOP	02-22-2-L	XO SR	51.0	0	0		
BOP		BOF	02-27-2-L	T/S	46.5	0	0		
BOP		BOP	02-32-2-Q	HW HTR LKR	7.5	0	0		
BOP		BOP	02-32-2-Q	HW HTR LKR	27.0	0	0		
BOP		BOF	02-33-2-L	T/S	37.5	0	0		
BOP		BOF	02-33-2-L	T/S	14.2	-99	-56	DJ	NC
BOP		BOF	02-33-2-L	T/S	37.5	0	0		
BOP		BOP	02-37-2-L	FIRST LT. SR (2)	55.5	0	0		
BOP	B06		(none)	(weather bulkhead)	60.0	0	0	DJ	NC
D06			01A-14-2-Q	FCSLE DECK UTILITY S	114.5	0	0		
D06			01A-34-0-Q	FCSLE DECK UTILITY S	25.5	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	147.8	0	0		
			02-32-2-Q	**HW HTR LKR**	**(CUI = QA)**				
BOP		B05	01-34-2A-T	VENT TRUNK	10.5	0	0		
BOP		BOP	02-20-0-L	PASSAGE	18.0	-30	-8	DJ	NC
BOP		BOP	02-20-0-L	PASSAGE	27.0	0	0		
BOP		BOP	02-30-2-L	OFFICERS SR (2)	7.5	0	0		
BOP		BOP	02-30-2-L	OFFICERS SR (2)	27.0	0	0		
D06			01A-14-2-Q	FCSLE DECK UTILITY S	8.6	0	0		
D00			02A-14-0-Q	UPPER DECK UTILITY S	8.6	0	0		
			02-33-1-L	**T/S**	**(CUI = LW)**				
BOF		BOP	02-20-0-L	PASSAGE	43.5	0	0		
BOF		BOP	02-30-1-L	OFFICERS SR (2)	34.5	0	0		
BOF		BOP	02-30-1-L	OFFICERS SR (2)	15.0	-99	-56	DJ	NC
BOF		BOP	02-30-1-L	OFFICERS SR (2)	34.5	0	0		
BOF		BOF	02-36-1-L	T/S	46.5	0	0		
D06			01A-14-1-Q	FCSLE DECK UTILITY S	20.1	0	0		
D06			01A-34-1-Q	FCSLE DECK UTILITY S	14.9	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	35.0	0	0		
			02-33-2-L	**T/S**	**(CUI = LW)**				
BOF		BOP	02-30-2-L	OFFICERS SR (2)	37.5	0	0		
BOF		BOP	02-30-2-L	OFFICERS SR (2)	14.2	-99	-56	DJ	NC
BOF		BOP	02-30-2-L	OFFICERS SR (2)	37.5	0	0		
BOF		BOP	02-37-2-L	FIRST LT. SR (2)	49.5	0	0		
BOF	B06		(none)	(weather bulkhead)	45.0	0	0		
D06			01A-14-2-Q	FCSLE DECK UTILITY S	9.7	0	0		
D06			01A-34-0-Q	FCSLE DECK UTILITY S	29.0	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	38.8	0	0		
			02-35-1-L	**OPS. OFF. SR (2)**	**(CUI = L2)**				
BOP		B06	1-40-1-T	UPTAKE	39.0	0	0		
BOP		B06	1-40-1-T	UPTAKE	31.5	0	0		
BOP		BOP	02-20-0-L	PASSAGE	48.0	-99	-56	DJ	NC
BOP		BOP	02-30-1-L	OFFICERS SR (2)	67.5	0	0		
BOP		BOF	02-36-1-L	T/S	39.0	0	0		
BOP		BOF	02-36-1-L	T/S	17.5	-99	-56	DJ	NC
BOP		BOF	02-36-1-L	T/S	37.5	0	0		
BOP		B06	02-42-1-Q	FAN RM	75.0	0	0		
BOP	B06		(none)	(weather bulkhead)	70.5	0	0	DJ	NC
D06			01A-34-1-Q	FCSLE DECK UTILITY S	141.4	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	141.4	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			02-36-1-L	**T/S**	**(CUI**	**= LW)**			
BOF		BOP	02-20-0-L	PASSAGE	54.0	0	0		
BOF		BOF	02-33-1-L	T/S	46.5	0	0		
BOF		BOP	02-35-1-L	OPS. OFF. SR (2)	39.0	0	0		
BOF		BOP	02-35-1-L	OPS. OFF. SR (2)	17.5	-99	-56	DJ	NC
BOF		BOP	02-35-1-L	OPS. OFF. SR (2)	37.5	0	0		
D06			01A-34-1-Q	FCSLE DECK UTILITY S	43.4	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	43.4	0	0		
			02-37-2-L	**FIRST LT. SR (2)**	**(CUI**	**= L2)**			
BOP		B06	1-40-4-T	UPTAKE	42.0	0	0		
BOP		B06	1-40-4-T	UPTAKE	13.5	0	0		
BOP		B05	01-34-2A-T	VENT TRUNK	10.5	0	0		
BOP		B05	01-34-2A-T	VENT TRUNK	10.5	0	0		
BOP		BOP	02-20-0-L	PASSAGE	72.0	-99	-56	DJ	NC
BOP		BOP	02-30-2-L	OFFICERS SR (2)	55.5	0	0		
BOP		BOF	02-33-2-L	T/S	49.5	0	0		
BOP		BOF	02-41-2-L	T/S	34.5	0	0		
BOP		BOF	02-41-2-L	T/S	20.2	-99	-56	DJ	NC
BOP		BOP	02-42-2-A	CG LKR	24.0	0	0		
BOP	B06		(none)	(weather bulkhead)	55.5	0	0	DJ	NC
D06			01A-34-0-Q	FCSLE DECK UTILITY S	134.6	0	0		
DOC			02A-14-0-Q	UPPER DECK UTILITY S	137.2	0	0		
			02-41-2-L	**T/S**	**(CUI**	**= LW)**			
BOF		B06	1-40-4-T	UPTAKE	48.0	0	0		
BOF		BOP	02-37-2-L	FIRST LT. SR (2)	34.5	0	0		
BOF		BOP	02-37-2-L	FIRST LT. SR (2)	20.2	-99	-56	DJ	NC
BOF		BOP	02-42-2-A	CG LKR	34.5	0	0		
BOF	B06		(none)	(weather bulkhead)	49.5	0	0		
D06			01A-34-0-Q	FCSLE DECK UTILITY S	40.4	0	0		
DOF			02A-14-0-Q	UPPER DECK UTILITY S	40.4	0	0		
			02-42-1-Q	**FAN RM**	**(CUI**	**= QF)**			
B06		B05	1-40-1-T	UPTAKE	45.0	0	0		
B06		B05	1-40-1-T	UPTAKE	12.0	0	0		
B06		B05	02-20-0-L	PASSAGE	30.0	0	0	DWT	X
B06		BOP	02-35-1-L	OPS. OFF. SR (2)	75.0	0	0		
B05		B06	02A-14-0-Q	UPPER DECK UTILITY S	20.0	0	0		
B05		B06	02A-14-0-Q	UPPER DECK UTILITY S	8.0	-5	-5		
B06	B06		(none)	(weather bulkhead)	75.0	0	0		
B05	B06		(none)	(weather bulkhead)	20.0	0	0		
B06	B06		(none)	(weather bulkhead)	15.0	0	0		
B05	B06		(none)	(weather bulkhead)	4.0	0	0		
D06			01A-34-1-Q	FCSLE DECK UTILITY S	60.0	0	0		
D06			(none)	(weather overhead)	60.0	0	0		
			02-42-2-A	**CG LKR**	**(CUI**	**= AG)**			
BOP		BOP	02-20-0-L	PASSAGE	34.5	-30	-8	DJ	NC
BOP		BOP	02-37-2-L	FIRST LT. SR (2)	24.0	0	0		
BOP		BOF	02-41-2-L	T/S	34.5	0	0		
BOP	B06		(none)	(weather bulkhead)	24.0	0	0		
D06			01A-34-0-Q	FCSLE DECK UTILITY S	14.7	0	0		
D00			02A-14-0-Q	UPPER DECK UTILITY S	14.7	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name / Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			02A-14-0-Q	**UPPER DECK UTILITY SPACE NO.1**	**(CUI = QF)**				
B06		B05	1-40-1-T	UPTAKE	10.4	0	0		
B06		B05	1-40-1-T	UPTAKE	8.4	0	0		
B06		B05	1-40-4-T	UPTAKE	11.2	0	0		
B06		B05	1-40-4-T	UPTAKE	16.4	0	0		
B05		B05	01-34-2A-T	VENT TRUNK	12.0	0	0		
B05		B05	01-34-2A-T	VENT TRUNK	2.8	0	0		
B05		B05	01-34-2A-T	VENT TRUNK	12.0	0	0		
B05		B05	01-34-2A-T	VENT TRUNK	2.8	0	0		
B05		B05	02-25-1-L	STAIRWAY	8.0	0	0		
B05		B05	02-25-1-L	STAIRWAY	8.0	0	0		
B05		B05	02-25-1-L	STAIRWAY	28.8	0	0		
B06		B05	02-42-1-Q	FAN RM	20.0	0	0		
B06		B05	02-42-1-Q	FAN RM	8.0	-5	-5		
B05		B05	02A-22-1-Q	UPPER DECK UTILITY S	27.2	0	0		
B05		B05	02A-22-1-Q	UPPER DECK UTILITY S	27.6	0	0		
B05	B06		(none)	(weather bulkhead)	24.0	0	0		
B05	B06		(none)	(weather bulkhead)	8.0	0	0		
B05	B06		(none)	(weather bulkhead)	28.8	0	0		
B05	B06		(none)	(weather bulkhead)	42.8	0	0		
B05	B06		(none)	(weather bulkhead)	30.0	0	0		
B05	B06		(none)	(weather bulkhead)	42.8	0	0		
B05	B06		(none)	(weather bulkhead)	8.0	0	0		
B05	B06		(none)	(weather bulkhead)	24.0	0	0		
B05	B06		(none)	(weather bulkhead)	68.0	0	0		
DOF			02-14-1-L	T/S	36.4	0	0		
DOC			02-14-2-L	EO SR	174.7	0	0		
DOC			02-14-3-L	CO SR	171.2	0	0		
DOF			02-18-2-L	T/S	32.9	0	0		
DOC			02-20-0-L	PASSAGE	396.5	0	0		
DOC			02-22-2-L	XO SR	135.0	0	0		
DOF			02-27-2-L	T/S	33.5	0	0		
DOC			02-30-1-L	OFFICERS SR (2)	147.4	0	0		
DOC			02-30-2-L	OFFICERS SR (2)	147.8	0	0		
D00			02-32-2-Q	HW HTR LKR	8.6	0	0		
DOF			02-33-1-L	T/S	35.0	0	0		
DOF			02-33-2-L	T/S	38.8	0	0		
DOC			02-35-1-L	OPS. OFF. SR (2)	141.4	0	0		
DOF			02-36-1-L	T/S	43.4	0	0		
DOC			02-37-2-L	FIRST LT. SR (2)	137.2	0	0		
DOF			02-41-2-L	T/S	40.4	0	0		
D00			02-42-2-A	CG LKR	14.7	0	0		
D06			03-15-0-C	PILOT HOUSE	455.3	0	0		
D06			03-28-1-L	TOILET	6.4	0	0		
D06			(none)	(weather overhead)	1300.0	0	0		
			02A-22-1-Q	**UPPER DECK UTILITY SPACE NO.2**	**(CUI = QF)**				
B05		B05	02-25-1-L	STAIRWAY	28.8	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	27.2	0	0		
B05		B05	02A-14-0-Q	UPPER DECK UTILITY S	27.6	0	0		
B05	B06		(none)	(weather bulkhead)	28.8	0	0		
DOC			02-22-1-Q	SHIP'S OFFICE & SUPP	197.3	0	0		
D06			03-15-0-C	PILOT HOUSE	90.7	0	0		
D06			03-28-1-L	TOILET	9.6	0	0		
D06			(none)	(weather overhead)	97.0	0	0		

Table B.2.1 Barrier Data (continued)

<1>	<2>	<3>	Plan ID	Compartment Name	Adjacent Compartment	Area ft²	Therm adj	Durab adj	Doors/ Hatches	DC Rating
			03-15-0-C	**PILOT HOUSE**		(CUI = C)				
BOP		BOP	03-28-1-L		TOILET	36.0	-99	-56	DJ	NC
BOP	B06		(none)		(weather bulkhead)	243.7	0	0	DJ	NC
									DWT	Z
BOP	B06		(none)		(weather bulkhead)	243.7	0	0	DJ	NC
									DWT	Z
BOP	B06		(none)		(weather bulkhead)	180.0	0	0		
BOP	B06		(none)		(weather bulkhead)	36.0	0	0		
BOP	B06		(none)		(weather bulkhead)	144.0	0	0	DJ	NC
									DWT	Z
D00			02-25-1-L		STAIRWAY	48.0	0	0		
D06			02A-14-0-Q		UPPER DECK UTILITY S	455.3	0	0		
D06			02A-22-1-Q		UPPER DECK UTILITY S	90.7	0	0		
D06			(none)		(weather overhead)	594.0	0	0		
			03-28-1-L	**TOILET**		(CUI = LW)				
BOP		BOP	03-15-0-C		PILOT HOUSE	36.0	-99	-56	DJ	NC
BOP	B06		(none)		(weather bulkhead)	36.0	0	0		
BOP	B06		(none)		(weather bulkhead)	36.0	0	0		
BOP	B06		(none)		(weather bulkhead)	36.0	0	0		
D06			02A-14-0-Q		UPPER DECK UTILITY S	6.4	0	0		
D06			02A-22-1-Q		UPPER DECK UTILITY S	9.6	0	0		
D06			(none)		(weather overhead)	16.0	0	0		

B.3 FIRE SAFETY OBJECTIVES

- Magnitude of Acceptable Loss (MAL)
- Frequency of Acceptable Loss (FAL)

SOURCES

- The components that comprise the Magnitude of Acceptable Loss (MAL) ratings were assigned using engineering judgment, and based on experience gained assigning these components to similar compartments on cutters analyzed previously.
- MAL and Frequency of Acceptable Loss Ratings (FAL) were calculated using the formulas described below.

ASSUMPTIONS

- None

DATA

- MAL component abbreviations used are:

LS = LIFE SAFETY	PM = PRIMARY MISSION
PP = PROPERTY PROTECTION	SM = SECONDARY MISSIONS

- MAL ratings of 1-4 are assigned to each component for each compartment that correspond to the following defined points in the fire growth curve:
  1. EB not acceptable
  2. EB acceptable, FRI not acceptable
  3. FRI acceptable, CBO not acceptable
  4. CBO acceptable
- The following formula is used to calculate the MAL rating for each compartment. Note the overall MAL rating assigned is the truncated integer value (the value without truncation is used to calculate the FAL rating):

$$MAL=0.1*LS+0.3*PP+0.4*PM+0.2*SM$$

The formula used to derive FAL from MAL is:

$$FAL=32.25-(1.766*MAL)-(0.214*MAL^2)-(0.222*MAL^3)$$

Table B.3.1 documents the baseline MAL ratings and FAL values assigned to/calculated for each compartment.

Table B.3.1 Fire Safety Objectives

		MAL Components				MAL	FAL
Plan ID	Compartment Name	LS	PP	PM	SM	Ratings	Years
CUI=AG	**(Gear Locker)**						
1-6-1-A	CHAIN LKR	4	4	4	3	3	10
1-6-2-A	CHAIN LKR	4	4	4	3	3	10
1-28-2-A	CBR LKR	2	4	4	4	3	10
1-40-2-A	CG LKR	4	4	4	4	4	8
1-62-1-A	DC LKR	2	4	4	4	3	10
01-54-4-A	CG LKR	4	4	4	4	4	8
02-42-2-A	CG LKR	4	4	4	4	4	8
CUI=AR	**(Refrigerated Storage)**						
1-14-1-A	FREEZE ROOM	4	4	4	4	4	8
1-18-1-A	THAW ROOM	4	4	4	4	4	8
1-18-3-A	CHILL ROOM	4	4	4	4	4	8
CUI=AS	**(Storeroom)**						
2-24-2-A	ENGR STRM	4	4	4	4	4	8
1-D-0-A	STEWARD STOREROOM	4	4	4	4	4	8
1-6-3-A	DRY PROVISIONS STRM	4	4	4	4	4	8
1-40-3-A	HALON CYLINDER STWG	2	4	4	4	3	10
1-40-6-A	BAGGAGE STRM	4	4	4	4	4	8
01-G-0-A	BOSUN STORES	3	4	4	4	3	9
01-1-2-A	STRM NO 2	4	4	4	3	3	10
01-2-1-A	STRM NO 1	4	4	4	3	3	10
01-40-1-A	SPONSOR STRM	4	4	4	4	4	8
CUI=C	**(Ship Control /Communications)**						
2-52-0-C	MAIN CONTROL STATION	2	2	2	2	2	26
01-54-1-C	COMMUNICATION CTR	2	3	2	3	2	23
03-15-0-C	PILOT HOUSE	2	3	2	2	2	24
CUI=EE	**(Main Propulsion - Electrical)**						
3-52-01-E	PROPULSION MTR RM	3	2	2	2	2	26
CUI=EM	**(Main Propulsion - Mechanical)**						
3-34-0-E	MAIN GENERATOR RM	3	2	2	2	2	26
2-6-0-E	BOW THRUSTER ELEC MTR RM	3	2	2	2	2	26
CUI=K	**(Hazardous Material Storage)**						
01-64-2-K	ARMORY/LAW ENFORCEMENT CENTER	2	4	2	4	3	19
CUI=L1	**(Senior Officer's Cabin)**						
02-14-2-L	EO SR	3	4	4	4	3	9
02-14-3-L	CO SR	3	4	4	4	3	9
02-22-2-L	XO SR	3	4	4	4	3	9
CUI=L2	**(Officer/CPO Quarters)**						
01-14-1-L	CREW SR (2)	3	4	4	4	3	9
01-14-4-L	CREW SR (2)	3	4	4	4	3	9
01-19-1-L	CREW SR (2)	3	4	4	4	3	9
01-21-2-L	CREW SR (2)	3	4	4	4	3	9
01-24-1-L	CREW SR (2)	3	4	4	4	3	9
01-30-1-L	CREW SR (2)	3	4	4	4	3	9
02-30-1-L	OFFICERS SR (2)	3	4	4	4	3	9
02-30-2-L	OFFICERS SR (2)	3	4	4	4	3	9
02-35-1-L	OPS. OFF. SR (2)	3	4	4	4	3	9
02-37-2-L	FIRST LT. SR (2)	3	4	4	4	3	9

Table B.3.1 Fire Safety Objectives (continued)

Plan ID	Compartment Name	MAL Components LS	PP	PM	SM	MAL Ratings	FAL Years
CUI=L5	**(Crews Berthing)**						
1-24-2-L	CREWS SR (3)	3	4	4	4	3	9
1-30-2-L	CREWS SR (3)	3	4	4	4	3	9
1-45-2-L	CREWS SR (6)	3	4	4	4	3	9
1-54-2-L	CREWS SR (3)	3	4	4	4	3	9
1-58-2-L	CREWS SR (3)	3	4	4	4	3	9
1-63-2-L	CREWS SR (3)	3	4	4	4	3	9
1-68-2-L	CREWS SR (3)	3	4	4	4	3	9
01-28-2-L	CREW SR (3)	3	4	4	4	3	9
01-34-2-L	CREW SR (3)	3	4	4	4	3	9
01-34-3-L	CREW SR (3)	3	4	4	4	3	9
01-44-2-L	CREW SR (3)	3	4	4	4	3	9
01-47-1-L	CREW SR (3)	3	4	4	4	3	9
01-57-2-L	PASSENGER BERTHING (6)	3	4	4	4	3	9
CUI=LL	**(Wardroom/Mess/Lounge Areas)**						
1-14-2-L	RECREATION ROOM	3	4	4	4	3	9
1-22-3-L	EXERCISE RM	3	4	4	4	3	9
1-34-1-L	WARDROOM	3	4	3	3	3	16
1-52-1-L	CREWS MESSROOM	3	4	2	2	2	22
01-61-0-L	TRAINING RM/ CREWS LOUNGE	3	4	4	4	3	9
CUI=LM	**(Medical/Dental Spaces)**						
1-30-1-L	HOSPITAL	3	4	3	3	3	16
CUI=LP	**(Passageway/Staircase/Vestibule)**						
3-72-1-L	TUNNEL	3	4	3	3	3	16
2-24-0-L	PASSAGE	3	4	3	3	3	16
2-86-1-L	TUNNEL	3	4	3	3	3	16
1-9-0-L	PASSAGE	3	4	3	3	3	16
1-9-0A-L	PASSAGE	3	4	3	3	3	16
1-9-0B-L	PASSAGE	3	4	3	3	3	16
1-22-1-L	STWY	3	4	3	3	3	16
2-22-1-L	STWY	3	4	3	3	3	16
1-68-1-L	STWY	3	4	3	3	3	16
1-72-2-L	VESTIBULE	3	4	3	3	3	16
01-2-0-L	PASSAGE	3	4	3	3	3	16
01-10-0-L	PASSAGE	3	4	3	3	3	16
01-10-0A-L	PASSAGE	3	4	3	3	3	16
01-10-0B-L	PASSAGE	3	4	3	3	3	16
01-22-1-L	STAIRWAY	3	4	3	3	3	16
01-54-2-L	VESTIBULE	3	4	3	3	3	16
01-61-2-L	PASSAGE	3	4	3	3	3	16
02-20-0-L	PASSAGE	3	4	3	3	3	16
02-25-1-L	STAIRWAY	3	4	3	3	3	16

Table B.3.1 Fire Safety Objectives (continued)

		MAL Components				MAL	FAL
Plan ID	Compartment Name	LS	PP	PM	SM	Ratings	Years
CUI=LW	(Sanitary Spaces)						
1-28-4-L	T/S	4	4	4	4	4	8
1-32-1-L	T/S	4	4	4	4	4	8
1-48-2-L	T/S	4	4	4	4	4	8
1-57-2-L	T/S	4	4	4	4	4	8
1-66-2-L	T/S	4	4	4	4	4	8
01-14-2-L	T/S	4	4	4	4	4	8
01-17-1-L	T/S	4	4	4	4	4	8
01-26-2-L	T/S	4	4	4	4	4	8
01-27-1-L	T/S	4	4	4	4	4	8
01-34-1-L	T/S	4	4	4	4	4	8
01-41-2-L	T/S	4	4	4	4	4	8
01-46-1-L	T/S	4	4	4	4	4	8
01-54-6-L	T/S	4	4	4	4	4	8
02-14-1-L	T/S	4	4	4	4	4	8
02-18-2-L	T/S	4	4	4	4	4	8
02-27-2-L	T/S	4	4	4	4	4	8
02-33-1-L	T/S	4	4	4	4	4	8
02-33-2-L	T/S	4	4	4	4	4	8
02-36-1-L	T/S	4	4	4	4	4	8
02-41-2-L	T/S	4	4	4	4	4	8
03-28-1-L	TOILET	4	4	4	4	4	8
CUI=QA	(Aux Machinery Spaces)						
2-24-4-Q	A/C MCHRY SPACE	3	2	3	3	2	22
2-29-1-Q	SEWAGE MCHRY RM	3	3	4	4	3	13
2-94-0-Q	STEERING GEAR RM	3	2	2	2	2	26
01-69-1-Q	HYD. POWER RM.	3	3	2	2	2	24
02-32-2-Q	HW HTR LKR	4	4	4	4	4	8
CUI=QE	(Emergency Aux Generator Spaces)						
01-6-0-Q	EMER SWBD & GEN RM	3	2	3	3	2	22
CUI=QF	(Fan Room)						
1-34-2-Q	FAN ROOM	3	3	3	3	3	19
1-68-3-Q	FAN ROOM	3	3	3	3	3	19
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2	3	4	4	4	3	9
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	3	4	4	4	3	9
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3	3	4	4	4	3	9
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	3	4	4	4	3	9
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5	3	4	4	4	3	9
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7	3	4	4	4	3	9
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1	3	4	4	4	3	9
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2	3	4	4	4	3	9
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4	3	4	4	4	3	9
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	3	4	4	4	3	9
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5	3	4	4	4	3	9
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6	3	4	4	4	3	9
02-42-1-Q	FAN RM	3	3	3	3	3	19
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1	3	4	4	4	3	9
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2	3	4	4	4	3	9

Table B.3.1 Fire Safety Objectives (continued)

Plan ID	Compartment Name	MAL Components LS	PP	PM	SM	MAL Ratings	FAL Years
CUI=QG	(Galley/Pantry/Scullery)						
1-42-1-Q	GALLEY	3	3	2	2	2	24
1-44-2-Q	SCULLERY	3	3	2	2	2	24
CUI=QL	(Laundry)						
2-24-1-Q	LAUNDRY RM	4	4	3	3	3	15
2-24-1A-Q	LAUNDRY RM	4	4	3	3	3	15
CUI=QO	(Office Spaces)						
1-6-4-Q	SHIP STORE	4	4	4	4	4	8
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	3	4	3	3	3	16
CUI=QS	(Shops)						
1-62-3-Q	GENERAL WORKSHOP	3	4	4	4	3	9
1-75-0-Q	D.C. SHOP	3	4	3	3	3	16
01-68-0-Q	ELECT. & ELECTRICAL SHOP	3	4	4	4	3	9
CUI=TH	(Trunks/Hoists/Dumbwaiters)						
4-24-1-T	SPEED LOG XDCR TRUNK	4	4	2	2	2	21
4-31-1-T	TRANSDUCER TRUNK	4	4	2	2	2	21
1-46-1-T	MCHRY ACC. & REMOVAL TRUNK	3	4	3	3	3	16
01-34-2A-T	VENT TRUNK	4	4	4	4	4	8
CUI=TU	(Stacks/Engine Uptakes)						
1-40-1-T	UPTAKE	4	4	2	2	2	21
1-40-4-T	UPTAKE	4	4	2	2	2	21
CUI=V	(Voids/Cofferdams)						
4-34-1-V	VOID	4	4	4	4	4	8
4-34-2-V	VOID	4	4	4	4	4	8
CUI=W	(Water Tank (empty))						
4-B-0-W	FOREPEAK BALLAST TANK	4	4	4	4	4	8
4-6-1-W	BALLAST TANK	4	4	4	4	4	8
4-6-2-W	BALLAST TANK	4	4	4	4	4	8
4-24-2-W	BALLAST TANK	4	4	4	4	4	8
4-24-3-W	BALLAST TANK	4	4	4	4	4	8
4-24-4-W	BALLAST TANK	4	4	4	4	4	8
3-52-02-W	POTABLE WATER	4	4	4	4	4	8
3-58-0-W	AUXILARY POTABLE WATER	4	4	4	4	4	8
4-86-1-W	BALLAST TANK	4	4	4	4	4	8
4-86-2-W	BALLAST TANK	4	4	4	4	4	8
2-31-1-W	SEWAGE HOLDING TANK	4	4	4	4	4	8
2-72-0-W	ANTI-ROLL TANK	4	4	4	4	4	8
3-94-1-W	AFTER PEAK BALLAST TANK	4	4	4	4	4	8
3-94-2-W	AFTER PEAK BALLAST TANK	4	4	4	4	4	8

B.4 FIRE DETECTION

- Automatic Detection Systems
- Percent Time Monitored
- Estimated Time to Detection (Td)

SOURCES

- Percent monitored values were assigned using engineering judgment, and based on experience gained assigning these values to similar compartments on cutters analyzed previously.
- The estimated time to detection was calculated by SAFE in accordance with Chapter V, Section C of Reference F, based on the assigned percent monitored values.
- Automatic detection equipment shown in Table B.4.1 is based on information collected during the ship visit. Additional automatic detectors are required in spaces such as berthing areas and passageways to bring the ship into compliance with applicable Coast Guard regulations.

ASSUMPTIONS

- Automatic detection equipment essentially provides monitoring 100% of the time in compartments with detectors installed whether the ship is in port or at sea. To account for reliability of equipment, 95% was assigned in lieu of 100%.

DATA

- Table B.4.1 documents the quantity and type of automatic detection systems presently installed in each compartment as well as the percent time monitored both in port and at sea. It also lists the calculated estimated time to detection.

Table B.4.1 Fire Detection

Plan ID	Compartment Name	Detection Systems	% Time at Sea	Monitored in Port	Est. Minutes at Sea	to Detect. in Port
CUI=AG	**(Gear Locker)**					
1-6-1-A	CHAIN LKR	None	0	0	16	16
1-6-2-A	CHAIN LKR	None	0	0	16	16
1-28-2-A	CBR LKR	None	5	5	15	15
1-40-2-A	CG LKR	None	5	5	15	15
1-62-1-A	DC LKR	None	5	5	15	15
01-54-4-A	CG LKR	None	5	5	15	15
02-42-2-A	CG LKR	None	5	5	15	15
CUI=AR	**(Refrigerated Storage)**					
1-14-1-A	FREEZE ROOM	None	5	5	15	15
1-18-1-A	THAW ROOM	None	5	5	15	15
1-18-3-A	CHILL ROOM	None	5	5	15	15
CUI=AS	**(Storeroom)**					
2-24-2-A	ENGR STRM	1 Ioniz Smoke	95	95	1	1
1-D-0-A	STEWARD STOREROOM	1 Ioniz Smoke	95	95	1	1
1-6-3-A	DRY PROVISIONS STRM	1 Ioniz Smoke	95	95	1	1
1-40-3-A	HALON CYLINDER STWG	None	5	5	15	15
1-40-6-A	BAGGAGE STRM	None	5	5	15	15
01-G-0-A	BOSUN STORES	1 Ioniz Smoke	95	95	1	1
01-1-2-A	STRM NO 2	1 Temp	95	95	1	1
01-2-1-A	STRM NO 1	1 Ioniz Smoke	95	95	1	1
01-40-1-A	SPONSOR STRM	1 Ioniz Smoke	95	95	1	1
CUI=C	**(Ship Control/Communications)**					
2-52-0-C	MAIN CONTROL STATION	1 Ioniz Smoke	95	95	1	1
01-54-1-C	COMMUNICATION CTR	None	95	25	1	11
03-15-0-C	PILOT HOUSE	None	95	10	1	14
CUI=EE	**(Main Propulsion - Electrical)**					
3-52-01-E	PROPULSION MTR RM	6 Ioniz Smoke	95	95	1	1
CUI=EM	**(Main Propulsion - Mechanical)**					
3-34-0-E	MAIN GENERATOR RM	2 Ioniz Smoke 2 Temp	95	95	1	1
2-6-0-E	BOW THRUSTER ELEC MTR RM	1 Ioniz Smoke	95	95	1	1
CUI=K	**(Hazardous Material Storage)**					
01-64-2-K	ARMORY/LAW ENFORCE.CENTER	None	95	95	1	1
CUI=L1	**(Senior Officer's Cabin)**					
02-14-2-L	EO SR	None	50	25	6	11
02-14-3-L	CO SR	None	50	25	6	11
02-22-2-L	XO SR	None	50	25	6	11
CUI=L2	**(Officer/CPO Quarters)**					
01-14-1-L	CREW SR (2)	None	35	25	9	11
01-14-4-L	CREW SR (2)	None	35	25	9	11
01-19-1-L	CREW SR (2)	None	35	25	9	11
01-21-2-L	CREW SR (2)	None	35	25	9	11
01-24-1-L	CREW SR (2)	None	35	25	9	11
01-30-1-L	CREW SR (2)	None	35	25	9	11
02-30-1-L	OFFICERS SR (2)	None	50	25	6	11
02-30-2-L	OFFICERS SR (2)	None	50	25	6	11
02-35-1-L	OPS. OFF. SR (2)	None	50	25	6	11
02-37-2-L	FIRST LT. SR (2)	None	50	25	6	11

Table B.4.1 Fire Detection (continued)

Plan ID	Compartment Name	Detection Systems	% Time at Sea	Monitored in Port	Est. Minutes at Sea	to Detect. in Port
CUI=L5	(Crews Berthing)					
1-24-2-L	CREWS SR (3)	None	35	25	9	11
1-30-2-L	CREWS SR (3)	None	35	25	9	11
1-45-2-L	CREWS SR (6)	None	35	25	9	11
1-54-2-L	CREWS SR (3)	None	35	25	9	11
1-58-2-L	CREWS SR (3)	None	35	25	9	11
1-63-2-L	CREWS SR (3)	None	35	25	9	11
1-68-2-L	CREWS SR (3)	None	35	25	9	11
01-28-2-L	CREW SR (3)	None	35	25	9	11
01-34-2-L	CREW SR (3)	None	35	25	9	11
01-34-3-L	CREW SR (3)	None	35	25	9	11
01-44-2-L	CREW SR (3)	None	35	25	9	11
01-47-1-L	CREW SR (3)	None	35	25	9	11
01-57-2-L	PASSENGER BERTHING (6)	None	50	25	6	11
CUI=LL	(Wardroom/Mess/Lounge Areas)					
1-14-2-L	RECREATION ROOM	None	20	60	12	4
1-22-3-L	EXERCISE RM	None	20	40	12	8
1-34-1-L	WARDROOM	None	50	35	6	9
1-52-1-L	CREWS MESSROOM	None	35	25	9	11
01-61-0-L	TRAINING RM/ CREWS LOUNGE	None	50	50	6	6
CUI=LM	(Medical/Dental Spaces)					
1-30-1-L	HOSPITAL	None	5	5	15	15
CUI=LP	(Passageway/Staircase/Vestibule)					
3-72-1-L	TUNNEL	None	20	15	12	13
2-24-0-L	PASSAGE	None	30	30	10	10
2-86-1-L	TUNNEL	None	20	15	12	13
1-9-0-L	PASSAGE	1 Ioniz Smoke	95	95	1	1
1-9-0A-L	PASSAGE	None	95	95	1	1
1-9-0B-L	PASSAGE	None	95	95	1	1
1-22-1-L	STWY	None	40	40	8	8
2-22-1-L	STWY	None	30	30	10	10
1-68-1-L	STWY	None	20	15	12	13
1-72-2-L	VESTIBULE	None	20	15	12	13
01-2-0-L	PASSAGE	None	95	95	1	1
01-10-0-L	PASSAGE	1 Ioniz Smoke	95	95	1	1
01-10-0A-L	PASSAGE	None	95	95	1	1
01-10-0B-L	PASSAGE	1 Ioniz Smoke	95	95	1	1
01-22-1-L	STAIRWAY	1 Ioniz Smoke	95	95	1	1
01-54-2-L	VESTIBULE	None	30	30	10	10
01-61-2-L	PASSAGE	1 Ioniz Smoke	95	95	1	1
02-20-0-L	PASSAGE	2 Ioniz Smoke	95	95	1	1
02-25-1-L	STAIRWAY	None	95	10	1	14

Table B.4.1 Fire Detection (continued)

Plan ID	Compartment Name	Detection Systems	% Time at Sea	Monitored in Port	Est. Minutes at Sea	to Detect. in Port
CUI=LW	(Sanitary Spaces)					
1-28-4-L	T/S	None	5	5	15	15
1-32-1-L	T/S	None	5	5	15	15
1-48-2-L	T/S	None	5	5	15	15
1-57-2-L	T/S	None	5	5	15	15
1-66-2-L	T/S	None	5	5	15	15
01-14-2-L	T/S	None	5	5	15	15
01-17-1-L	T/S	None	5	5	15	15
01-26-2-L	T/S	None	5	5	15	15
01-27-1-L	T/S	None	5	5	15	15
01-34-1-L	T/S	None	5	5	15	15
01-41-2-L	T/S	None	5	5	15	15
01-46-1-L	T/S	None	5	5	15	15
01-54-6-L	T/S	None	5	5	15	15
02-14-1-L	T/S	None	5	5	15	15
02-18-2-L	T/S	None	5	5	15	15
02-27-2-L	T/S	None	5	5	15	15
02-33-1-L	T/S	None	5	5	15	15
02-33-2-L	T/S	None	5	5	15	15
02-36-1-L	T/S	None	5	5	15	15
02-41-2-L	T/S	None	5	5	15	15
03-28-1-L	TOILET	None	5	5	15	15
CUI=QA	(Aux Machinery Spaces)					
2-24-4-Q	A/C MCHRY SPACE	None	10	10	14	14
2-29-1-Q	SEWAGE MCHRY RM	None	10	10	14	14
2-94-0-Q	STEERING GEAR RM	1 Ioniz Smoke	95	95	1	1
01-69-1-Q	HYD. POWER RM.	None	10	10	14	14
02-32-2-Q	HW HTR LKR	None	10	10	14	14
CUI=QE	(Emergency Aux Generator Spaces)					
01-6-0-Q	EMER SWBD & GEN RM	2 Ioniz Smoke	95	95	1	1
CUI=QF	(Fan Room)					
1-34-2-Q	FAN ROOM	None	5	5	15	15
1-68-3-Q	FAN ROOM	None	5	5	15	15
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2	None	0	0	16	16
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	None	0	0	16	16
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3	None	0	0	16	16
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	None	0	0	16	16
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5	None	0	0	16	16
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7	None	0	0	16	16
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1	None	0	0	16	16
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2	None	0	0	16	16
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4	None	0	0	16	16
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	None	0	0	16	16
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5	None	0	0	16	16
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6	None	0	0	16	16
02-42-1-Q	FAN RM	None	5	5	15	15
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1	None	0	0	16	16
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2	None	0	0	16	16
CUI=QG	(Galley/Pantry/Scullery)					
1-42-1-Q	GALLEY	1 Ioniz Smoke	95	95	1	1
1-44-2-Q	SCULLERY	None	50	25	6	11

Table B.4.1 Fire Detection (continued)

Plan ID	Compartment Name	Detection Systems	% Time at Sea	Monitored in Port	Est. Minutes at Sea	to Detect. in Port
CUI=QL	**(Laundry)**					
2-24-1-Q	LAUNDRY RM	None	15	10	13	14
2-24-1A-Q	LAUNDRY RM	None	15	10	13	14
CUI=QO	**(Office Spaces)**					
1-6-4-Q	SHIP STORE	None	5	5	15	15
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	1 Ioniz Smoke	95	95	1	1
CUI=QS	**(Shops)**					
1-62-3-Q	GENERAL WORKSHOP	None	20	30	12	10
1-75-0-Q	D.C. SHOP	None	20	30	12	10
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	None	20	30	12	10
CUI=TH	**(Trunks/Hoists/Dumbwaiters)**					
4-24-1-T	SPEED LOG XDCR TRUNK	None	0	0	16	16
4-31-1-T	TRANSDUCER TRUNK	None	0	0	16	16
1-46-1-T	MCHRY ACCESS & REMOVAL TRUNK	None	20	15	12	13
01-34-2A-T	VENT TRUNK	None	0	0	16	16
CUI=TU	**(Stacks/Engine Uptakes)**					
1-40-1-T	UPTAKE	None	0	0	16	16
1-40-4-T	UPTAKE	None	0	0	16	16
CUI=V	**(Voids/Cofferdams)**					
4-34-1-V	VOID	None	0	0	16	16
4-34-2-V	VOID	None	0	0	16	16
CUI=W	**(Water Tank (empty))**					
4-B-0-W	FOREPEAK BALLAST TANK	None	0	0	16	16
4-6-1-W	BALLAST TANK	None	0	0	16	16
4-6-2-W	BALLAST TANK	None	0	0	16	16
4-24-2-W	BALLAST TANK	None	0	0	16	16
4-24-3-W	BALLAST TANK	None	0	0	16	16
4-24-4-W	BALLAST TANK	None	0	0	16	16
3-52-02-W	POTABLE WATER	None	0	0	16	16
3-58-0-W	AUXILARY POTABLE WATER	None	0	0	16	16
4-86-1-W	BALLAST TANK	None	0	0	16	16
4-86-2-W	BALLAST TANK	None	0	0	16	16
2-31-1-W	SEWAGE HOLDING TANK	None	0	0	16	16
2-72-0-W	ANTI-ROLL TANK	None	0	0	16	16
3-94-1-W	AFTER PEAK BALLAST TANK	None	0	0	16	16
3-94-2-W	AFTER PEAK BALLAST TANK	None	0	0	16	16

B.5 AUTOMATED AND MANUAL SUPPRESSION

- Installed Automated Fire Protection Systems
- Manual Fire Extinguishing Equipment Available

SOURCES

- Automated fire protection systems and manual fire extinguishing equipment available to each compartment shown in Table B.5.1 is based on observations and information collected during the ship visit.

ASSUMPTIONS

- Presently, most of the manual fire extinguishing equipment including fire hoses and portable fire extinguishers have been removed in conjunction with this conversion project. Following completion of the conversion project it is assumed that all compartments will have the correct number and type of portable extinguishers installed in, or located within 30 feet of the compartment.

- All compartments can be serviced from a minimum of two existing firemain stations equipped with adequate lengths of hose.

DATA

- Table B.5.1 documents the location, type and number of installed automated fire protection systems and manual fire extinguishing equipment available to each compartment.

Table B.5.1 Automated and Manual Fire Protection Systems

Plan ID	Compartment Name	Fixed Systems (Installed)	Firefighting Portable Extinguishers	Manual Equipment Hose/ AFFF	(Available) Fire Main
CUI=AG	**(Gear Locker)**				
1-6-1-A	CHAIN LKR	None	1 PKP	None	1 SW
1-6-2-A	CHAIN LKR	None	1 PKP	None	1 SW
1-28-2-A	CBR LKR	None	1 PKP	None	1 SW
1-40-2-A	CG LKR	None	1 PKP	None	1 SW
1-62-1-A	DC LKR	None	1 CO_2/1 PKP	None	1 SW
01-54-4-A	CG LKR	None	1 PKP	None	1 SW
02-42-2-A	CG LKR	None	1 PKP	None	1SW
CUI=AR	**(Refrigerated Storage)**				
1-14-1-A	FREEZE ROOM	None	1 PKP	None	1SW
1-18-1-A	THAW ROOM	None	1 PKP	None	1 SW
1-18-3-A	CHILL ROOM	None	1 PKP	None	1 SW
CUI=AS	**(Storeroom)**				
2-24-2-A	ENGR STRM	None	1 PKP	None	1 SW
1-D-0-A	STEWARD STOREROOM	None	1 PKP	None	1 SW
1-6-3-A	DRY PROVISIONS STRM	None	1 PKP	None	1 SW
1-40-3-A	HALON CYLINDER STWG	None	1 PKP	None	1 SW
1-40-6-A	BAGGAGE STRM	None	1 PKP	None	1 SW
01-G-0-A	BOSUN STORES	None	1 PKP	None	1 SW
01-1-2-A	STRM NO 2	None	1 PKP	None	1 SW
01-2-1-A	STRM NO 1	None	1 PKP	None	1 SW
01-40-1-A	SPONSOR STRM	None	1 PKP	None	1 SW
CUI=C	**(Ship Control/Communications)**				
2-52-0-C	MAIN CONTROL STATION	None	1 CO_2/1 PKP	None	1 SW
01-54-1-C	COMMUNICATION CTR	None	1 PKP	None	1 SW
03-15-0-C	PILOT HOUSE	None	1 CO_2/1 PKP	None	1 SW
CUI=EE	**(Main Propulsion - Electrical)**				
3-52-01-E	PROPULSION MTR RM	2 CO_2/1 HALON	3 CO_2/3 PKP	1 AFFF/SW	2 SW
CUI=EM	**(Main Propulsion - Mechanical)**				
3-34-0-E	MAIN GENERATOR RM	1 HALON	4 PKP	1 AFFF/SW	2 SW
2-6-0-E	BOW THRUSTER ELEC MTR RM	1 HALON	1 PKP	None	1 SW
CUI=K	**(Hazardous Material Storage)**				
01-64-2-K	ARMORY/LAW ENFORCE. CENTER	None	1 PKP	None	1 SW
CUI=L1	**(Senior Officer's Cabin)**				
02-14-2-L	EO SR	None	1 PKP	None	1 SW
02-14-3-L	CO SR	None	1 PKP	None	1 SW
02-22-2-L	XO SR	None	1 PKP	None	1 SW
CUI=L2	**(Officer/CPO Quarters)**				
01-14-1-L	CREW SR (2)	None	1 PKP	None	1 SW
01-14-4-L	CREW SR (2)	None	1 PKP	None	1 SW
01-21-2-L	CREW SR (2)	None	1 PKP	None	1 SW
01-24-1-L	CREW SR (2)	None	1 PKP	None	1 SW
01-30-1-L	CREW SR (2)	None	1 PKP	None	1 SW
02-30-1-L	OFFICERS SR (2)	None	1 PKP	None	1 SW
02-30-2-L	OFFICERS SR (2)	None	1 PKP	None	1 SW
02-35-1-L	OPS. OFF. SR (2)	None	1 PKP	None	1 SW
02-37-2-L	FIRST LT. SR (2)	None	1 PKP	None	1 SW
CUI=L5	**(Crews Berthing)**				
1-24-2-L	CREWS SR (3)	None	1 PKP	None	1 SW
1-30-2-L	CREWS SR (3)	None	1 PKP	None	1 SW
1-45-2-L	CREWS SR (6)	None	1 PKP	None	1 SW
1-54-2-L	CREWS SR (3)	None	1 PKP	None	1 SW
1-58-2-L	CREWS SR (3)	None	1 PKP	None	1 SW
1-63-2-L	CREWS SR (3)	None	1 PKP	None	1 SW
1-68-2-L	CREWS SR (3)	None	1 PKP	None	1 SW
01-28-2-L	CREW SR (3)	None	1 PKP	None	1 SW
01-34-2-L	CREW SR (3)	None	1 PKP	None	1 SW
01-34-3-L	CREW SR (3)	None	1 PKP	None	1 SW

Table B.5.1 Automated and Manual Fire Protection Systems (continued)

Plan ID	Compartment Name	Fixed Systems (Installed)	Firefighting Portable Extinguishers	Manual Equipment Hose/ AFFF	(Available) Fire Main
01-44-2-L	CREW SR (3)	None	1 PKP	None	1 SW
01-47-1-L	CREW SR (3)	None	1 PKP	None	1 SW
01-57-2-L	PASSENGER BERTHING (6)	None	1 PKP	1 AFFF/SW	1 SW
CUI=LL	(Wardroom/Mess/Lounge Areas)				
1-14-2-L	RECREATION ROOM	None	1 PKP	None	1 SW
1-22-3-L	EXERCISE RM	None	1 PKP	None	1 SW
1-34-1-L	WARDROOM	None	1 PKP	None	1 SW
1-52-1-L	CREWS MESSROOM	None	1 PKP	None	1 SW
01-61-0-L	TRAINING RM/ CREWS LOUNGE	None	1 PKP	None	1 SW
CUI=LM	(Medical/Dental Spaces)				
1-30-1-L	HOSPITAL	None	1 PKP	None	1 SW
CUI=LP	(Passageway/Staircase/Vestibule)				
3-72-1-L	TUNNEL	None	1 PKP	1 AFFF/SW	1 SW
2-24-0-L	PASSAGE	None	1 PKP	None	1 SW
2-86-1-L	TUNNEL	None	1 CO_2/1 PKP	None	1 SW
1-9-0-L	PASSAGE	None	2 PKP	None	1 SW
1-9-0A-L	PASSAGE	None	2 PKP	1 AFFF/SW	1 SW
1-9-0B-L	PASSAGE	None	2 PKP	None	1 SW
1-22-1-L	STWY	None	1 PKP	None	1 SW
2-22-1-L	STWY	None	1 PKP	None	1 SW
1-68-1-L	STWY	None	1 CO_2/3 PKP	None	1 SW
1-72-2-L	VESTIBULE	None	1 PKP	None	1 SW
01-2-0-L	PASSAGE	None	1 PKP	None	1 SW
01-10-0-L	PASSAGE	None	2 PKP	None	1 SW
01-10-0A-L	PASSAGE	None	2 PKP	1 AFFF/SW	1 SW
01-10-0B-L	PASSAGE	None	2 PKP	None	1 SW
01-22-1-L	STAIRWAY	None	1 PKP	None	1 SW
01-54-2-L	VESTIBULE	None	1 PKP	None	1 SW
01-61-2-L	PASSAGE	None	1 PKP	None	1 SW
02-20-0-L	PASSAGE	None	1 PKP	None	2 SW
02-25-1-L	STAIRWAY	None	1 PKP	None	1 SW
CUI=LW	(Sanitary Spaces)				
1-28-4-L	T/S	None	1 PKP	None	1 SW
1-32-1-L	T/S	None	1 PKP	None	1 SW
1-48-2-L	T/S	None	1 PKP	None	1 SW
1-57-2-L	T/S	None	1 PKP	None	1 SW
1-66-2-L	T/S	None	1 PKP	None	1 SW
01-14-2-L	T/S	None	1 PKP	None	1 SW
01-17-1-L	T/S	None	1 PKP	None	1 SW
01-26-2-L	T/S	None	1 PKP	None	1 SW
01-27-1-L	T/S	None	1 PKP	None	1 SW
01-34-1-L	T/S	None	1 PKP	None	1 SW
01-41-2-L	T/S	None	1 PKP	None	1 SW
01-46-1-L	T/S	None	1 PKP	None	1 SW
01-54-6-L	T/S	None	1 PKP	None	1 SW
02-14-1-L	T/S	None	1 PKP	None	1 SW
02-18-2-L	T/S	None	1 PKP	None	1 SW
02-27-2-L	T/S	None	1 PKP	None	1 SW
02-33-1-L	T/S	None	1 PKP	None	1 SW
02-33-2-L	T/S	None	1 PKP	None	1 SW
02-36-1-L	T/S	None	1 PKP	None	1 SW
02-41-2-L	T/S	None	1 PKP	None	1 SW
03-28-1-L	TOILET	None	1 PKP	None	1 SW

Table B.5.1 Automated and Manual Fire Protection Systems (continued)

Plan ID	Compartment Name	Fixed Systems (Installed)	Firefighting Portable Extinguishers	Manual Equipment Hose/ AFFF	(Available) Fire Main
CUI=QA	(Aux Machinery Spaces)				
2-24-4-Q	A/C MCHRY SPACE	None	1 PKP	None	1 SW
2-29-1-Q	SEWAGE MCHRY RM	None	1 PKP	None	1 SW
2-94-0-Q	STEERING GEAR RM	None	1 PKP	1 AFFF/SW	1 SW
01-69-1-Q	HYD. POWER RM.	1 HALON	1 PKP	None	1 SW
02-32-2-Q	HW HTR LKR	None	1 PKP	None	1 SW
CUI=QE	(Emergency Aux Generator Spaces)				
01-6-0-Q	EMER SWBD & GEN RM	1 HALON	2 PKP	None	1 SW
CUI=QF	(Fan Room)				
1-34-2-Q	FAN ROOM	None	1 PKP	None	1 SW
1-68-3-Q	FAN ROOM	None	1 PKP	None	1 SW
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2	None	1 PKP	None	1 SW
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	None	1 PKP	None	1 SW
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3	None	1 PKP	None	1 SW
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	None	1 PKP	None	1 SW
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5	None	1 PKP	None	1 SW
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7	None	1 PKP	None	1 SW
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1	None	1 PKP	None	1 SW
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2	None	1 PKP	None	1 SW
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4	None	1 PKP	None	1 SW
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	None	1 PKP	None	1 SW
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5	None	1 PKP	None	1 SW
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6	None	1 PKP	None	1 SW
02-42-1-Q	FAN RM	None	1 PKP	None	1 SW
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1	None	1 PKP	None	1 SW
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2	None	1 PKP	None	1 SW
CUI=QG	(Galley/Pantry/Scullery)				
1-42-1-Q	GALLEY	1 APC	1 PKP	None	1 SW
1-44-2-Q	SCULLERY	None	1 PKP	None	1 SW
CUI=QL	(Laundry)				
2-24-1-Q	LAUNDRY RM	None	1 PKP	None	1 SW
2-24-1A-Q	LAUNDRY RM	None	1 PKP	None	1 SW
CUI=QO	(Office Spaces)				
1-6-4-Q	SHIP STORE	None	1 PKP	None	1 SW
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	None	1 PKP	None	1 SW
CUI=QS	(Shops)				
1-62-3-Q	GENERAL WORKSHOP	None	1 PKP	None	1 SW
1-75-0-Q	D.C. SHOP	None	1 PKP	None	1 SW
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	1 HALON	1 PKP	None	1 SW
CUI=TH	(Trunks/Hoists/Dumbwaiters)				
4-24-1-T	SPEED LOG XDCR TRUNK	None	1 PKP	None	1 SW
4-31-1-T	TRANSDUCER TRUNK	None	1 PKP	None	1 SW
01-34-2A-T	VENT TRUNK	None	1 PKP	None	1 SW
CUI=TU	(Stacks/Engine Uptakes)				
1-40-1-T	UPTAKE	None	1 PKP	None	1 SW
1-40-4-T	UPTAKE	None	1 PKP	None	1 SW
CUI=V	(Voids/Cofferdams)				
4-34-1-V	VOID	None	1 PKP	None	1 SW
4-34-2-V	VOID	None	1 PKP	None	1 SW

Table B.5.1 Automated and Manual Fire Protection Systems (continued)

Plan ID	Compartment Name	Fixed Systems (Installed)	Firefighting Manual Equipment (Available): Portable Extinguishers	Hose/ AFFF	Fire Main
CUI=W	**(Water Tank (empty))**				
4-B-0-W	FOREPEAK BALLAST TANK	None	1 PKP	None	1 SW
4-6-1-W	BALLAST TANK	None	1 PKP	None	1 SW
4-6-2-W	BALLAST TANK	None	1 PKP	None	1 SW
4-24-2-W	BALLAST TANK	None	1 PKP	None	1 SW
4-24-3-W	BALLAST TANK	None	1 PKP	None	1 SW
4-24-4-W	BALLAST TANK	None	1 PKP	None	1 SW
3-52-02-W	POTABLE WATER	None	1 PKP	None	1 SW
3-58-0-W	AUXILARY POTABLE WATER	None	1 PKP	None	1 SW
4-86-1-W	BALLAST TANK	None	1 PKP	None	1 SW
4-86-2-W	BALLAST TANK	None	1 PKP	None	1 SW
2-31-1-W	SEWAGE HOLDING TANK	None	1 PKP	None	1 SW
2-72-0-W	ANTI-ROLL TANK	None	1 PKP	None	1 SW
3-94-1-W	AFTER PEAK BALLAST TANK	None	1 PKP	None	1 SW
3-94-2-W	AFTER PEAK BALLAST TANK	None	1 PKP	None	1 SW

B.6 PROBABILITY OF FLAME TERMINATION

- Probability of Flame Termination by Self-Termination (I)
- Probability of Flame Termination by Automated Fire Extinguishing Systems (A)
- Probability of Flame Termination by Manual Firefighting Efforts (M)
- Frequency of Established Burning (EB)

SOURCES

- I, A and M values given EB were assigned by engineering judgment and based on default values as described in Section 3.2.3 of this report and corresponding values assigned on cutters analyzed earlier, References I, J, and K.
- I, A and M values given Tbar and given Dbar were calculated using formulas documented in Appendix J of Reference F.
- Frequency of Established Burning (EB) values were obtained from Section 2.2.3.1 of this report.

ASSUMPTIONS

- A probability of A given EB in the Motor Room is based on the Halon 1301 system installed in the space and not influenced by the installed CO_2 flooding systems for each main motor. The most likely fire scenario in the Motor Room is an electrical fire in a main motor. (The A values for this scenario are similar to those for the Motor Room due to the presence of the installed CO_2 system.)

- The probability of A given EB in the Galley is based on the installed K_2CO_3 system installed for the galley stove. This value is considered applicable only to fires involving the galley stove which is considered the most likely fire scenario in the Galley.

DATA

- Table B.6.1 documents the probabilities of flame termination values assigned/calculated for each compartment for both active (A and M) and passive (I) suppression.

Table B.6 Probability of Flame Termination

Plan ID	Compartment Name	I: IEB	I: ITBAR	I: IDBAR	A: IEB	A: ITBAR	A: IDBAR	M: IEB	M: ITBAR	M: IDBAR
CUI=AG	**(Gear Locker) Freq. of EB=0.0010**									
1-6-1-A	CHAIN LKR	99	100	59	0	0	0	95	100	57
1-6-2-A	CHAIN LKR	99	100	59	0	0	0	95	100	57
1-28-2-A	CBR LKR	27	33	16	0	0	0	20	24	12
1-40-2-A	CG LKR	27	33	16	0	0	0	25	30	15
1-62-1-A	DC LKR	27	33	16	0	0	0	25	30	15
01-54-4-A	CG LKR	27	33	16	0	0	0	20	24	12
02-42-2-A	CG LKR	27	33	16	0	0	0	25	30	15
CUI=AR	**(Refrig Storage) Freq. of EB=0.0009**									
1-14-1-A	FREEZE ROOM	70	84	56	0	0	0	34	40	27
1-18-1-A	THAW ROOM	70	84	56	0	0	0	34	40	27
1-18-3-A	CHILL ROOM	70	84	56	0	0	0	34	40	27
CUI=AS	**(Storeroom) Freq. of EB=0.0009**									
2-24-2-A	ENGR STRM	39	42	23	0	0	0	20	40	20
1-D-0-A	STEWARD STOREROOM	39	42	23	0	0	0	20	40	20
1-6-3-A	DRY PROVISIONS STRM	39	42	23	0	0	0	20	40	20
1-40-3-A	HALON CYLINDER STWG	60	66	36	0	0	0	20	40	20
1-40-6-A	BAGGAGE STRM	39	42	23	0	0	0	20	40	20
01-G-0-A	BOSUN STORES	39	42	23	0	0	0	20	40	20
01-1-2-A	STRM NO 2	39	42	23	0	0	0	20	40	20
01-2-1-A	STRM NO 1	39	42	23	0	0	0	20	40	20
01-40-1-A	SPONSOR STRM	39	42	23	0	0	0	20	40	20
CUI=C	**(Ship Cont/Comm) Freq. of EB=0.0012**									
2-52-0-C	MAIN CONTROL STATION	39	42	23	0	0	0	30	33	18
01-54-1-C	COMMUNICATION CTR	39	42	23	0	0	0	25	27	15
03-15-0-C	PILOT HOUSE	70	77	42	0	0	0	25	27	15
CUI=EE	**(Main Prop/Electri) Freq. of EB=0.0031**									
3-52-01-E	PROPULSION MTR RM	20	22	12	70	70	35	25	31	15
CUI=EM	**(Main Prop/ Mech) Freq. of EB=0.0272**									
3-34-0-E	MAIN GENERATOR RM	43	47	25	70	70	35	20	25	12
2-6-0-E	BOW THRUSTER ELEC MTR RM	43	47	25	67	67	33	10	12	6
CUI=K	**(Haz MatStorage) Freq. of EB=0.0013**									
01-64-2-K	ARMORY/LAW ENFORC CENTER	16	16	8	0	0	0	11	11	5
CUI=L1	**(Sr Officer's Cabin) Freq. of EB=0.0008**									
02-14-2-L	EO SR	19	22	9	0	0	0	25	32	15
02-14-3-L	CO SR	19	22	9	0	0	0	25	32	15
02-22-2-L	XO SR	19	22	9	0	0	0	25	32	15
CUI=L2	**(Off/CPO Qrtrs) Freq. of EB=0.0008**									
01-14-1-L	CREW SR (2)	28	30	16	0	0	0	20	32	14
01-14-4-L	CREW SR (2)	28	30	16	0	0	0	20	32	14
01-19-1-L	CREW SR (2)	28	30	16	0	0	0	20	32	14
01-21-2-L	CREW SR (2)	28	30	16	0	0	0	20	32	14
01-24-1-L	CREW SR (2)	28	30	16	0	0	0	20	32	14
01-30-1-L	CREW SR (2)	28	30	16	0	0	0	20	32	14
02-30-1-L	OFFICERS SR (2)	28	30	16	0	0	0	20	32	14
02-30-2-L	OFFICERS SR (2)	28	30	16	0	0	0	20	32	14
02-35-1-L	OPS. OFF. SR (2)	28	30	16	0	0	0	20	32	14
02-37-2-L	FIRST LT. SR (2)	28	30	16	0	0	0	20	32	14

Table B.6 Probability of Flame Termination (continued)

Plan ID	Compartment Name	I EB	I TBAR	I DBAR	A EB	A TBAR	A DBAR	M EB	M TBAR	M DBAR
CUI=L5	(Crews Berthing) Freq. of EB=0.0008									
1-24-2-L	CREWS SR (3)	36	36	21	0	0	0	15	30	13
1-30-2-L	CREWS SR (3)	36	36	21	0	0	0	15	30	13
1-45-2-L	CREWS SR (6)	36	36	21	0	0	0	15	30	13
1-54-2-L	CREWS SR (3)	36	36	21	0	0	0	15	30	13
1-58-2-L	CREWS SR (3)	36	36	21	0	0	0	15	30	13
1-63-2-L	CREWS SR (3)	36	36	21	0	0	0	15	30	13
1-68-2-L	CREWS SR (3)	36	36	21	0	0	0	15	30	13
01-28-2-L	CREW SR (3)	36	36	21	0	0	0	15	30	13
01-34-2-L	CREW SR (3)	36	36	21	0	0	0	15	30	13
01-34-3-L	CREW SR (3)	36	36	21	0	0	0	15	30	13
01-44-2-L	CREW SR (3)	36	36	21	0	0	0	15	30	13
01-47-1-L	CREW SR (3)	36	36	21	0	0	0	15	30	13
01-57-2-L	PASSENGER BERTHING (6)	30	30	18	0	0	0	26	52	23
CUI=LL	(Ward/Mess/Lng) Freq. of EB=0.0008									
1-14-2-L	RECREATION ROOM	30	33	18	0	0	0	20	25	12
1-22-3-L	EXERCISE RM	50	55	30	0	0	0	35	43	21
1-34-1-L	WARDROOM	39	42	23	0	0	0	20	25	12
1-52-1-L	CREWS MESSROOM	39	42	23	0	0	0	20	25	12
01-61-0-L	TRAINING RM/ CREWS LOUNGE	39	42	23	0	0	0	20	25	12
CUI=LM	(Med/Dent Spaces) Freq. of EB=0.0004									
1-30-1-L	HOSPITAL	46	50	27	0	0	0	25	31	15
CUI=LP	(Pass/Stair/Vestib) Freq. of EB=0.0001									
3-72-1-L	TUNNEL	32	32	28	0	0	0	15	16	13
2-24-0-L	PASSAGE	78	78	70	0	0	0	48	52	43
2-86-1-L	TUNNEL	32	32	28	0	0	0	15	16	13
1-9-0-L	PASSAGE	78	78	70	0	0	0	48	52	43
1-9-0A-L	PASSAGE	78	78	70	0	0	0	48	52	43
1-9-0B-L	PASSAGE	78	78	70	0	0	0	48	52	43
1-22-1-L	STWY	85	85	76	0	0	0	48	52	43
2-22-1-L	STWY	85	85	76	0	0	0	48	52	43
1-68-1-L	STWY	85	85	76	0	0	0	48	52	43
1-72-2-L	VESTIBULE	78	78	70	0	0	0	48	52	43
01-2-0-L	PASSAGE	78	78	70	0	0	0	48	52	43
01-10-0-L	PASSAGE	78	78	70	0	0	0	48	52	43
01-10-0A-L	PASSAGE	78	78	70	0	0	0	48	52	43
01-10-0B-L	PASSAGE	78	78	70	0	0	0	48	52	43
01-22-1-L	STAIRWAY	85	85	76	0	0	0	48	52	43
01-54-2-L	VESTIBULE	78	78	70	0	0	0	48	52	43
01-61-2-L	PASSAGE	78	78	70	0	0	0	48	52	43
02-20-0-L	PASSAGE	78	78	70	0	0	0	48	52	43
02-25-1-L	STAIRWAY	85	85	76	0	0	0	48	52	43

Table B.6 Probability of Flame Termination (continued)

Plan ID	Compartment Name	I			A			M		
		IEB	ITBAR	IDBAR	IEB	ITBAR	IDBAR	IEB	ITBAR	IDBAR
CUI=LW	(Sanitary Spaces) Freq. of EB=0.0002									
1-28-4-L	T/S	20	20	16	0	0	0	10	11	9
1-32-1-L	T/S	20	20	16	0	0	0	10	11	9
1-48-2-L	T/S	20	20	16	0	0	0	10	11	9
1-57-2-L	T/S	20	20	16	0	0	0	10	11	9
1-66-2-L	T/S	20	20	16	0	0	0	10	11	9
01-14-2-L	T/S	20	20	16	0	0	0	10	11	9
01-17-1-L	T/S	20	20	16	0	0	0	10	11	9
01-26-2-L	T/S	20	20	16	0	0	0	10	11	9
01-27-1-L	T/S	20	20	16	0	0	0	10	11	9
01-34-1-L	T/S	20	20	16	0	0	0	10	11	9
01-41-2-L	T/S	20	20	16	0	0	0	10	11	9
01-46-1-L	T/S	20	20	16	0	0	0	10	11	9
01-54-6-L	T/S	20	20	16	0	0	0	10	11	9
02-14-1-L	T/S	20	20	16	0	0	0	10	11	9
02-18-2-L	T/S	20	20	16	0	0	0	10	11	9
02-27-2-L	T/S	20	20	16	0	0	0	10	11	9
02-33-1-L	T/S	20	20	16	0	0	0	10	11	9
02-33-2-L	T/S	20	20	16	0	0	0	10	11	9
02-36-1-L	T/S	20	20	16	0	0	0	10	11	9
02-41-2-L	T/S	20	20	16	0	0	0	10	11	9
03-28-1-L	TOILET	20	20	16	0	0	0	70	77	63
CUI=QA	(Aux Mach Spaces) Freq. of EB=0.0029									
2-24-4-Q	A/C MCHRY SPACE	50	50	35	0	0	0	10	11	7
2-29-1-Q	SEWAGE MCHRY RM	50	50	35	0	0	0	10	11	7
2-94-0-Q	STEERING GEAR RM	50	50	35	0	0	0	10	11	7
01-69-1-Q	HYD. POWER RM.	50	50	35	67	67	33	10	11	7
02-32-2-Q	HW HTR LKR	50	50	35	0	0	0	50	55	37
CUI=QE	(Emer Aux Gen) Freq. of EB=0.0204									
01-6-0-Q	EMER SWBD & GEN RM	43	43	25	70	70	35	20	22	15
CUI=QF	(Fan Room) Freq. of EB=0.0004									
1-34-2-Q	FAN ROOM	72	57	43	0	0	0	10	25	7
1-68-3-Q	FAN ROOM	72	57	43	0	0	0	10	25	7
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2	72	57	43	0	0	0	10	25	7
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	72	57	43	0	0	0	10	25	7
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3	72	57	43	0	0	0	10	25	7
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	72	57	43	0	0	0	10	25	7
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5	72	57	43	0	0	0	10	25	7
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7	72	57	43	0	0	0	10	25	7
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1	72	57	43	0	0	0	10	25	7
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2	72	57	43	0	0	0	10	25	7
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4	72	57	43	0	0	0	10	25	7
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	72	57	43	0	0	0	10	25	7
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5	72	57	43	0	0	0	10	25	7
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6	72	57	43	0	0	0	10	25	7
02-42-1-Q	FAN RM	72	57	43	0	0	0	10	25	7
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1	72	57	43	0	0	0	10	25	7
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2	72	57	43	0	0	0	10	25	7
CUI=QG	(Gall/Pant/Scullery) Freq. of EB=0.0026									
1-42-1-Q	GALLEY	73	73	43	85	85	42	10	14	8
1-44-2-Q	SCULLERY	73	73	43	0	0	0	23	32	18

Table B.6 Probability of Flame Termination (continued)

Plan ID	Compartment Name	I			A			M		
		EB	TBAR	DBAR	EB	TBAR	DBAR	EB	TBAR	DBAR
CUI=QL	(Laundry) Freq. of EB=0.0031									
2-24-1-Q	LAUNDRY RM	21	26	15	0	0	0	23	34	13
2-24-1A-Q	LAUNDRY RM	21	26	15	0	0	0	23	34	13
CUI=QO	(Office Spaces) Freq. of EB=0.0004									
1-6-4-Q	SHIP STORE	32	38	19	0	0	0	20	25	12
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	32	38	19	0	0	0	15	18	9
CUI=QS	(Shops) Freq. of EB=0.0018									
1-62-3-Q	GENERAL WORKSHOP	43	47	25	0	0	0	15	18	9
1-75-0-Q	D.C. SHOP	43	47	25	0	0	0	23	27	13
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	43	47	25	67	67	33	23	27	13
CUI=TH	(Trunk/Hoist/Dumb) Freq. of EB=0.0001									
4-24-1-T	SPEED LOG XDCR TRUNK	90	99	54	0	0	0	34	40	20
4-31-1-T	TRANSDUCER TRUNK	90	99	54	0	0	0	34	40	20
1-46-1-T	MCHRY ACCESS & REMOVAL TRUNK	96	100	57	0	0	0	34	40	20
01-34-2A-T	VENT TRUNK	96	100	57	0	0	0	34	40	20
CUI=TU	(Stacks/Eng/Upt) Freq. of EB=0.0013									
1-40-1-T	UPTAKE	32	35	19	0	0	0	6	7	3
1-40-4-T	UPTAKE	32	35	19	0	0	0	6	7	3
CUI=V	(Voids/Cofferdams) Freq. of EB=0.0001									
4-34-1-V	VOID	99	99	99	0	0	0	95	95	95
4-34-2-V	VOID	99	99	99	0	0	0	95	95	95
CUI=W	(Water Tk (empty) Freq. of EB=0.0004									
4-B-0-W	FOREPEAK BALLAST TANK	100	100	100	0	0	0	95	95	95
4-6-1-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
4-6-2-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
4-24-2-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
4-24-3-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
4-24-4-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
3-52-02-W	POTABLE WATER	100	100	100	0	0	0	95	95	95
3-58-0-W	AUXILARY POTABLE WATER	100	100	100	0	0	0	95	95	95
4-86-1-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
4-86-2-W	BALLAST TANK	100	100	100	0	0	0	95	95	95
2-31-1-W	SEWAGE HOLDING TANK	100	100	100	0	0	0	95	95	95
2-72-0-W	ANTI-ROLL TANK	100	100	100	0	0	0	95	95	95
3-94-1-W	AFTER PEAK BALLAST TANK	100	100	100	0	0	0	95	95	95
3-94-2-W	AFTER PEAK BALLAST TANK	100	100	100	0	0	0	95	95	95

B.7 FUEL LOADS

- Cellulosics, Plastics and Flammable Liquids
- Fuel Stack Height
- Deck Area Occupied

SOURCES

- Fuel loads and percents of fuel stack height and deck area occupied were used to establish default values in accordance with Chapter IV, Section C.3.3.2 of Reference F.
- Weights of combustible materials shown in Attachment B.7.1 were determined in part from References L and M and estimated using engineering judgment.
- Contributions of barrier insulation to the fuel load was determined by multiplying the appropriate insulation standard value listed in Attachment B.7.1 by the area of the insulated barriers in a compartment as documented in Appendix C. Attachment B.7.1 is a list of standard values used when developing fuel load default values.

ASSUMPTIONS

General

- All cellulosic fuels were assumed to yield 8000 BTU per pound
- All plastic fuels and flammable liquids were assumed to yield 16000 BTU per pound
- All flammable liquids assumed to weigh 8.0 pounds per gallon
- All combustible materials contained within the structural or joiner boundaries of a compartment were assumed available for combustion

Hull Structure

- Assumed noncombustible

Electrical

- Cables area assumed to average one inch in diameter with an estimated weight of 0.75 pounds/foot. 25% of this weight is assumed to be insulation.
- Fluorescent lighting fixtures: Only the plexiglass translucent cover is considered combustible.
- Relay operated and portable battle lanterns: Only the plastic case assumed combustible - no allowance for batteries. Contents of, and wires to, distribution boxes, receptacles and switches considered insignificant.

Electronics

- Allowance of five pounds of plastic combustibles (wires, plastic plates, etc.) assumed for the contents of each major cabinet or console. Small boxes, speakers, telephones etc. considered insignificant

Outfit and Furnishings

- Interior painting assumed as negligible fuel load
- An allowance of 40 pounds per person is assumed for clothes and combustible personal effects
- An allowance of 30 pounds per bin or drawer is assumed for the combustible contents of storage lockers
- Deck coverings assumed to be totally combustible including weight of adhesives
- Insulation: Thermal insulation conforming to MIL-I-742C assumed incombustible with exception of binder. Binder assumed to equal 10% of the weight of the material
- Chairs: 4.5 pounds of combustibles (plastic) assumed for combustible padding in seats, and backs per person (3 person bench seat thus equals 13.5 pounds)
- Combustibles in Galley assumed to be two pounds of griddle grease/cooking oil, two pounds for each appliance and 40 pounds of combustible stores in cabinets

Auxiliary Machinery & Systems

- Ventilation ductwork and fittings, except insulation, assumed noncombustible
- PVC, and fiberglas reinforced piping assumed noncombustible due to non-flammable liquid in piping acting as heat sink.

DATA

- Table B.7.1 summarizes the fuel load densities for plastics and cellulosics as well as gallons of flammable liquids in each compartment
- The fuel stack height and deck area occupied is also tabulated in Table B.7.1 as a percent of compartment height.

Attachment B.7.1 Fuel Load Standard Values

Deck/Bulkhead Materials

Rubber mat and adhesive	1.76 lbs/sq ft
Nomex rug and blue glue	.396 lbs/sq ft
Vinyl asbestos tile & adhesive	1.22 lbs/sq ft
Acoustic Ceiling Panels	1.2 lbs/sq ft
Aluminum Sheathing w/ vinyl face	.033 lbs/sq ft
MJ Bulkhead Panel w/ vinyl face	.033 lbs/sq ft
MJ Bulkhead Panel w/ HP Laminate face	.21 lbs/sq ft

Insulation

2" MIL-I-742C Hull Board (overhead)	.062 lbs/sq ft
1" MIL-I-742C Hull Board (shell)	.038 lbs/sq ft
29mm Fiberglass Insulation Batting	.153 lbs/sq ft
38mm Fiberglass Insulation Batting	.201 lbs/sq ft
66.5mm Fiberglass Insulation Batting	.344 lbs/sq ft

Office Furniture

Laminate Top for Steel Desk	.077 lbs
Turnbull Chair	5.0 lbs
Type II chair w/ arms	4.5 lbs
Cork Bulletin Board	18.0 lbs
Type "A" Bulletin Board	42.0 lbs
Books on shelf	15 lbs/ft

Lighting Fixtures

Fluorescent overhead (2 tube)	3.44 lbs
Incandescent globe	1.0 lbs
Spot light	2.0 lbs
Portable lantern	3.5 lbs
Relay operated lantern	4.75 lbs
Bunk light	.5 lbs
Lavatory fixture	1.2 lbs

Cableways

17"/16"	2.81 lbs/ft
14"/13"	2.25 lbs/ft
12"/11"	1.88 lbs/ft
10"/9"	1.50 lbs/ft
8"/7"	1.13 lbs/ft
6"/5"	0.75 lbs/ft

Damage Control Equipment

OBA unit w/ 4 extra canisters	32.4 lbs
Fireaxe	7 lbs
Damage Control Diagrams	4 lbs/set
P-250 Exhaust hose	15 lbs
P-250 Suction Hose	20 lbs

Lifesaving Equipment

CO2 Inflatable lifejacket	5.4 lbs
Kapok lifejacket	10.5 lbs
Blankets (2), Sheets (2), Mattress, Pillow/case	34 lbs
Bunk privacy curtain	10 lbs

WR, WC, & SH Spaces Furnishings

Shower stall door	10.6 lbs
Toilet paper roll	1.0 lbs
Toilet seat	6.0 lbs

Miscellaneous

Accordion pleat curtain	1.5 lbs/sq ft
Clock	5 lbs
Push Broom	1.5 lbs

Storeroom Contents

Hemp (1")	.293 lbs/ft
Nylon (1/2")	.071 lbs/ft
Bosun's Chair	8 lbs

Table B.7 Fuel Loads

Plan ID	Compartment Name	Cellulosics (psf)	Plastics (psf)	Flam. Liq. (Gals.)	Total Fuel (kBTUs/sf)	Growth Model	Stack Ht. %	% Deck Occupied
CUI=AG	(Gear Locker)							
1-6-1-A	CHAIN LKR	1.0	0.5	0	16.0	16	NA	90
1-6-2-A	CHAIN LKR	1.0	0.5	0	16.0	16	NA	90
1-28-2-A	CBR LKR	10.0	3.0	0	128.0	16	NA	75
1-40-2-A	CG LKR	10.0	3.0	0	128.0	5	NA	75
1-62-1-A	DC LKR	10.0	3.0	0	128.0	5	NA	75
01-54-4-A	CG LKR	10.0	3.0	0	128.0	5	NA	75
02-42-2-A	CG LKR	10.0	3.0	0	128.0	5	NA	75
CUI=AR	(Refrigerated Storage)							
1-14-1-A	FREEZE ROOM	0.5	0.5	0	12.0	4	NA	75
1-18-1-A	THAW ROOM	0.5	0.5	0	12.0	4	NA	75
1-18-3-A	CHILL ROOM	0.5	0.5	0	12.0	4	NA	75
CUI=AS	(Storeroom)							
2-24-2-A	ENGR STRM	10.0	2.0	0	112.0	5	NA	75
1-D-0-A	STEWARD STOREROOM	13.0	2.7	0	147.2	5	NA	75
1-6-3-A	DRY PROVISIONS STRM	10.0	2.0	0	112.0	2	90	75
1-40-3-A	HALON CYLINDER STWG	1.0	0.2	0	11.2	16	NA	25
1-40-6-A	BAGGAGE STRM	10.0	2.0	0	112.0	5	NA	75
01-G-0-A	BOSUN STORES	10.0	4.0	0	144.0	2	90	75
01-1-2-A	STRM NO 2	10.0	2.0	0	112.0	2	90	75
01-2-1-A	STRM NO 1	10.0	2.0	0	112.0	2	90	75
01-40-1-A	SPONSOR STRM	10.0	2.0	0	112.0	2	90	75
CUI=C	(Ship Control/Communications)							
2-52-0-C	MAIN CONTROL STATION	6.9	1.2	0	73.8	7	NA	80
01-54-1-C	COMMUNICATION CTR	6.9	1.2	0	73.8	7	NA	80
03-15-0-C	PILOT HOUSE	6.9	1.2	0	73.8	8	NA	70
CUI=EE	(Main Propulsion-Electrical)							
3-52-01-E	PROPULSION MTR RM	0.5	1.0	0	20.0	13	NA	75
CUI=EM	(Main Propulsion-Mechanical)							
3-34-0-E	MAIN GENERATOR RM	0.7	0.8	60	23.5	13	NA	75
2-6-0-E	BOW THRUSTER ELEC MTR RM	0.7	0.8	0	17.6	13	NA	75
CUI=K	(Hazardous MaterialStorage)							
01-64-2-K	ARMORY/LAW ENFORCEMENT CENTER	1.0	0.2	0	11.2	7	NA	75
CUI=L1	(Senior Officer'sCabin)							
02-14-2-L	EO SR	7.9	1.8	0	92.0	10	NA	70
02-14-3-L	CO SR	7.9	1.8	0	92.0	10	NA	70
02-22-2-L	XO SR	7.9	1.8	0	92.0	10	NA	70
CUI=L2	(Officer/CPO Quarters)							
01-14-1-L	CREW SR (2)	9.9	2.0	0	111.2	10	NA	60
01-14-4-L	CREW SR (2)	9.9	2.0	0	111.2	10	NA	60
01-19-1-L	CREW SR (2)	9.9	2.0	0	111.2	10	NA	60
01-21-2-L	CREW SR (2)	9.9	2.0	0	111.2	10	NA	60
01-24-1-L	CREW SR (2)	9.9	2.0	0	111.2	10	NA	60
01-30-1-L	CREW SR (2)	9.9	2.0	0	111.2	10	NA	60
02-30-1-L	OFFICERS SR(2)	9.9	2.0	0	111.2	10	NA	60
02-30-2-L	OFFICERS SR(2)	9.9	2.0	0	111.2	10	NA	60
02-35-1-L	OPS. OFF. SR(2)	9.9	2.0	0	111.2	10	NA	60
02-37-2-L	FIRST LT. SR(2)	9.9	2.0	0	111.2	10	NA	60

Table B.7 Fuel Loads (continued)

Plan ID	Compartment Name	Cellulosics (psf)	Plastics (psf)	Flam. Liq. (Gals.)	Total Fuel (kBTUs/sf)	Growth Model	Stack Ht. %	% Deck Occupied
CUI=L5	**(Crews Berthing)**							
1-24-2-L	CREWS SR (3)	11.9	1.6	0	120.8	10	NA	50
1-30-2-L	CREWS SR (3)	11.9	1.6	0	120.8	10	NA	50
1-45-2-L	CREWS SR (6)	11.9	1.6	0	120.8	10	NA	50
1-54-2-L	CREWS SR (3)	11.9	1.6	0	120.8	10	NA	50
1-58-2-L	CREWS SR (3)	11.9	1.6	0	120.8	10	NA	50
1-63-2-L	CREWS SR (3)	11.9	1.6	0	120.8	10	NA	50
1-68-2-L	CREWS SR (3)	11.9	1.6	0	120.8	10	NA	50
01-28-2-L	CREW SR (3)	11.9	1.6	0	120.8	10	NA	50
01-34-2-L	CREW SR (3)	11.9	1.6	0	120.8	10	NA	50
01-34-3-L	CREW SR (3)	11.9	1.6	0	120.8	10	NA	50
01-44-2-L	CREW SR (3)	11.9	1.6	0	120.8	10	NA	50
01-47-1-L	CREW SR (3)	11.9	1.6	0	120.8	10	NA	50
01-57-2-L	PASSENGER BERTHING(6)	11.9	1.6	0	120.8	10	NA	50
CUI=LL	**(Wardroom/Mess/Lounge Areas)**							
1-14-2-L	RECREATION ROOM	5.9	2.6	0	88.8	9	NA	60
1-22-3-L	EXERCISE RM	5.9	2.6	0	88.8	16	NA	60
1-34-1-L	WARDROOM	5.9	2.6	0	88.8	9	NA	70
1-52-1-L	CREWS MESSROOM	5.9	2.6	0	88.8	9	NA	70
01-61-0-L	TRAINING RM/CREWS LOUNGE	5.9	2.6	0	88.8	9	NA	70
CUI=LM	**(Medical/Dental Spaces)**							
1-30-1-L	HOSPITAL	12.9	3.6	3	163.8	8	NA	75
CUI=LP	**(Passageway/Staircase/Vestibule)**							
3-72-1-L	TUNNEL	1.0	0.8	50	91.1	3	25	50
2-24-0-L	PASSAGE	1.0	0.8	0	20.0	15	NA	25
2-86-1-L	TUNNEL	1.0	0.8	50	100.0	3	25	50
1-9-0-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
1-9-0A-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
1-9-0B-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
1-22-1-L	STWY	3.9	1.4	0	52.8	14	NA	25
2-22-1-L	STWY	3.9	1.4	0	52.8	14	NA	25
1-68-1-L	STWY	3.9	1.4	0	52.8	14	NA	25
1-72-2-L	VESTIBULE	3.9	1.4	0	52.8	15	NA	25
01-2-0-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
01-10-0-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
01-10-0A-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
01-10-0B-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
01-22-1-L	STAIRWAY	3.9	1.5	0	55.2	14	NA	25
01-54-2-L	VESTIBULE	3.9	1.4	0	52.8	15	NA	25
01-61-2-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
02-20-0-L	PASSAGE	3.9	1.4	0	52.8	15	NA	25
02-25-1-L	STAIRWAY	3.9	1.4	0	52.8	14	NA	25

Table B.7 Fuel Loads (continued)

Plan ID	Compartment Name	Cellulosics (psf)	Plastics (psf)	Flam. Liq. (Gals.)	Total Fuel (kBTUs/sf)	Growth Model	Stack Ht. %	% Deck Occupied
CUI=LW	(Sanitary Spaces)							
1-28-4-L	T/S	1.0	13.3	0	220.8	11	NA	25
1-32-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
1-48-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
1-57-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
1-66-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-14-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-17-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-26-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-27-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-34-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-41-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-46-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
01-54-6-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-14-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-18-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-27-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-33-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-33-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-36-1-L	T/S	1.0	13.3	0	220.8	11	NA	25
02-41-2-L	T/S	1.0	13.3	0	220.8	11	NA	25
03-28-1-L	TOILET	1.0	0.5	0	16.0	16	NA	25
CUI=QA	(Aux Machinery Spaces)							
2-24-4-Q	A/C MCHRY SPACE	2.8	2.0	30	68.1	13	NA	75
2-29-1-Q	SEWAGE MCHRY RM	2.8	2.0	0	54.0	13	NA	75
2-94-0-Q	STEERING GEAR RM	2.8	2.0	10	58.1	13	NA	50
01-69-1-Q	HYD. POWER RM.	5.7	2.6	10	106.7	13	NA	75
02-32-2-Q	HW HTR LKR	5.7	2.6	0	86.8	5	NA	75
CUI=QE	(Emergency Aux Generator Spaces)							
01-6-0-Q	EMER SWBD & GEN RM	2.5	2.0	125	95.7	13	NA	75
CUI=QF	(Fan Room)							
1-34-2-Q	FAN ROOM	1.5	1.0	0	28.0	13	NA	75
1-68-3-Q	FAN ROOM	10.0	2.0	25	131.1	5	NA	75
1A-14-0-Q	MAIN DECK UTILITY SPACE NO.2	0.8	0.2	0	9.6	5	NA	50
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	0.8	0.2	0	9.6	5	NA	50
1A-34-1-Q	MAIN DECK UTILITY SPACE NO.3	0.8	0.2	0	9.6	5	NA	50
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	0.8	0.2	0	9.6	5	NA	50
1A-42-1-Q	MAIN DECK UTILITY SPACE NO.5	0.8	0.2	0	9.6	5	NA	50
1A-52-1-Q	MAIN DECK UTILITY SPACE NO.7	0.8	0.2	0	9.6	5	NA	50
01A-14-1-Q	FCSLE DECK UTILITY SPACE NO.1	0.8	0.2	0	9.6	5	NA	50
01A-14-2-Q	FCSLE DECK UTILITY SPACE NO.2	0.8	0.2	0	9.6	5	NA	50
01A-34-0-Q	FCSLE DECK UTILITY SPACE NO.4	0.8	0.2	0	9.6	5	NA	50
01A-34-1-Q	FCSLE DECK UTILITY SPACE NO.3	0.8	0.2	0	9.6	5	NA	50
01A-54-1-Q	FCSLE DECK UTILITY SPACE NO.5	0.8	0.2	0	9.6	5	NA	50
01A-54-2-Q	FCSLE DECK UTILITY SPACE NO.6	0.8	0.2	0	9.6	5	NA	50
02-42-1-Q	FAN RM	0.8	0.2	0	9.6	13	NA	75
02A-14-0-Q	UPPER DECK UTILITY SPACE NO.1	1.5	1.0	0	28.0	5	NA	50
02A-22-1-Q	UPPER DECK UTILITY SPACE NO.2	1.5	1.0	0	28.0	5	NA	50
CUI=QG	(Galley/Pantry/Scullery)							
1-42-1-Q	GALLEY	4.9	1.6	1	65.3	13	NA	60
1-44-2-Q	SCULLERY	4.9	1.6	0	64.8	13	NA	60

Table B.7 Fuel Loads (continued)

Plan ID	Compartment Name	Cellulosics (psf)	Plastics (psf)	Flam. Liq. (Gals.)	Total Fuel (kBTUs/sf)	Growth Model	Stack Ht. %	% Deck Occupied
CUI=QL	(Laundry)							
2-24-1-Q	LAUNDRY RM	6.0	2.0	0	80.0	12	NA	60
2-24-1A-Q	LAUNDRY RM	10.0	15.0	45	770.0	5	NA	70
CUI=QO	(Office Spaces)							
1-6-4-Q	SHIP STORE	12.9	3.6	0	160.8	6	NA	75
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	12.9	3.6	0	160.8	8	NA	60
CUI=QS	(Shops)							
1-62-3-Q	GENERAL WORKSHOP	3.3	0.9	5	43.8	13	NA	75
1-75-0-Q	D.C. SHOP	3.3	0.9	0	40.8	5	NA	75
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	3.3	0.9	0	40.8	7	NA	75
CUI=TH	(Trunks/Hoists/Dumbwaiters)							
4-24-1-T	SPEED LOG XDCR TRUNK	1.0	0.5	0	16.0	16	NA	100
4-31-1-T	TRANSDUCER TRUNK	1.0	0.5	0	16.0	16	NA	100
1-46-1-T	MCHRY ACCESS & REMOVAL TRUNK	1.0	0.5	0	16.0	14	NA	25
01-34-2A-T	VENT TRUNK	1.0	0.5	0	16.0	16	NA	100
CUI=TU	(Stacks/Engine Uptakes)							
1-40-1-T	UPTAKE	2.5	0.5	0	28.0	13	NA	75
1-40-4-T	UPTAKE	2.5	0.5	0	28.0	13	NA	75
CUI=V	(Voids/Cofferdams)							
4-34-1-V	VOID	0.2	0.1	0	2.8	16	NA	100
4-34-2-V	VOID	0.2	0.1	0	2.8	16	NA	100
CUI=W	(Water Tank (empty))							
4-B-0-W	FOREPEAK BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
4-6-1-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
4-6-2-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
4-24-2-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
4-24-3-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
4-24-4-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
3-52-02-W	POTABLE WATER	0.0	0.0	0	0.0	16	NA	100
3-58-0-W	AUXILARY POTABLE WATER	0.0	0.0	0	0.0	16	NA	100
4-86-1-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
4-86-2-W	BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
2-31-1-W	SEWAGE HOLDING TANK	0.0	0.0	0	0.0	16	NA	100
2-72-0-W	ANTI-ROLL TANK	0.0	0.0	0	0.0	16	NA	100
3-94-1-W	AFTER PEAK BALLAST TANK	0.0	0.0	0	0.0	16	NA	100
3-94-2-W	AFTER PEAK BALLAST TANK	0.0	0.0	0	0.0	16	NA	100

B.8 FIRE GROWTH MODELS, RATES AND FRI TIMES

- Fire Growth Models (FGM)
- Pre FRI Fire Growth Rates (Alpha)
- Maximum Heat Release Rates (Qmax)
- FRI Times
- Post FRI Heat Release Rates (Post FRI Q)

SOURCES

- Fire growth models were assigned by engineering judgment and based on the definitions contained in Table C-1, Appendix C, of Reference E.
- Fire growth (Alpha) and maximum heat release rates (Max Q) were determined by formula assigned to individual FGM shown in Appendix C of Reference E. Post-FRI Q rates were determined by formula as documented in Chapter VI of Reference E.
- FRI times were calculated using the Beyler-Peatross Algorithm incorporated in SAFE Version 2.2. Some adjustments to calculated FRI times were made.

ASSUMPTIONS

- None

DATA

- Table B.8.1 documents the various fire growth data and FRI times for each compartment.

Table B.8.1 Fire Growth Models, Rates, and FRI Times

Plan ID	Compartment Name	Growth Model	Alpha kW/sec^2	Max Q kW	FRI X	Time Y	(Min.) Z	Post- X	FRI Q Y	(kW) Z
CUI=AG	**(Gear Locker)**									
1-6-1-A	CHAIN LKR	16	0.001	29	∞	∞	∞	0	0	0
1-6-2-A	CHAIN LKR	16	0.001	30	∞	∞	∞	0	0	0
1-28-2-A	CBR LKR	16	0.001	103	5	5	5	5	5	5
1-40-2-A	CG LKR	5	0.100	100	12	12	12	5	5	5
1-62-1-A	DC LKR	5	0.100	78	∞	∞	∞	5	5	5
01-54-4-A	CG LKR	5	0.100	117	6	6	6	5	5	5
02-42-2-A	CG LKR	5	0.100	66	11	11	11	66	66	66
CUI=AR	**(Refrigerated Storage)**									
1-14-1-A	FREEZE ROOM	4	0.010	3861	5	5	5	2165	1	1
1-18-1-A	THAW ROOM	4	0.010	994	3	3	4	994	994	0
1-18-3-A	CHILL ROOM	4	0.010	3046	5	5	5	2165	1	1
CUI=AS	**(Storeroom)**									
2-24-2-A	ENGR STRM	5	0.100	479	14	14	14	5	5	5
1-D-0-A	STEWARD STOREROOM	5	0.100	734	8	8	8	734	734	734
1-6-3-A	DRY PROVISIONS STRM	2	0.010	17891	5	5	5	317	317	317
1-40-3-A	HALON CYLINDER STWG	16	0.001	6	∞	∞	∞	6	6	6
1-40-6-A	BAGGAGE STRM	5	0.100	153	15	15	15	0	0	0
01-G-0-A	BOSUN STORES	2	0.010	14558	5	5	5	14558	14558	14558
01-1-2-A	STRM NO 2	2	0.010	10524	4	4	4	98	98	98
01-2-1-A	STRM NO 1	2	0.010	8685	4	4	4	8685	8685	8685
01-40-1-A	SPONSOR STRM	2	0.010	8281	4	4	4	224	224	224
CUI=C	**(Ship Control/Communications)**									
2-52-0-C	MAIN CONTROL STATION	7	0.010	55231	8	8	8	6124	6124	1730
01-54-1-C	COMMUNICATION CTR	7	0.010	18717	5	5	5	1382	1382	1382
03-15-0-C	PILOT HOUSE	8	0.700	3118	4	4	4	3118	3118	3118
CUI=EE	**(Main Propulsion - Electrical)**									
3-52-01-E	PROPULSION MTR RM	13	0.200	129600	3	3	3	16435	16435	12837
CUI=EM	**(Main Propulsion - Mechanical)**									
3-34-0-E	MAIN GENERATOR RM	13	0.200	199872	3	3	3	60035	60035	60183
2-6-0-E	BOW THRUSTER ELEC MTR RM	13	0.200	39125	2	2	2	2830	2830	324
CUI=K	**(Hazardous Material Storage)**									
01-64-2-K	ARMORY/LAW ENFORCE. CNTR	7	0.010	1522	4	4	4	98	98	98
CUI=L1	**(Senior Officer's Cabin)**									
02-14-2-L	EO SR	10	0.100	458	10	10	10	458	458	458
02-14-3-L	CO SR	10	0.100	450	8	8	8	450	450	450
02-22-2-L	XO SR	10	0.100	354	8	8	8	354	354	354
CUI=L2	**(Officer/CPO Quarters)**									
01-14-1-L	CREW SR (2)	10	0.100	295	12	12	12	295	295	295
01-14-4-L	CREW SR (2)	10	0.100	257	13	13	13	257	257	257
01-19-1-L	CREW SR (2)	10	0.100	292	8	8	8	292	292	292
01-21-2-L	CREW SR (2)	10	0.100	313	8	8	8	313	313	313
01-24-1-L	CREW SR (2)	10	0.100	278	7	7	7	278	278	278
01-30-1-L	CREW SR (2)	10	0.100	306	7	7	7	306	306	306
02-30-1-L	OFFICERS SR (2)	10	0.100	332	9	9	9	332	332	332
02-30-2-L	OFFICERS SR (2)	10	0.100	333	8	8	8	333	333	333
02-35-1-L	OPS. OFF. SR (2)	10	0.100	318	18	18	18	318	318	318
02-37-2-L	FIRST LT. SR (2)	10	0.100	309	11	11	11	309	309	309

Table B.8.1 Fire Growth Models, Rates, and FRI Times (continued)

Plan ID	Compartment Name	Growth Model	Alpha kW/sec^2	Max Q kW	FRI Time (Min.) X	FRI Time (Min.) Y	FRI Time (Min.) Z	Post-FRI Q (kW) X	Post-FRI Q (kW) Y	Post-FRI Q (kW) Z
CUI=L5	**(Crews Berthing)**									
1-24-2-L	CREWS SR (3)	10	0.100	238	12	12	12	238	238	238
1-30-2-L	CREWS SR (3)	10	0.100	258	20	20	20	258	258	258
1-45-2-L	CREWS SR (6)	10	0.100	396	13	13	13	396	396	396
1-54-2-L	CREWS SR (3)	10	0.100	249	12	12	12	249	249	249
1-58-2-L	CREWS SR (3)	10	0.100	248	12	12	12	248	248	248
1-63-2-L	CREWS SR (3)	10	0.100	251	12	12	12	251	251	251
1-68-2-L	CREWS SR (3)	10	0.100	243	23	23	23	243	243	243
01-28-2-L	CREW SR (3)	10	0.100	275	11	11	11	275	275	275
01-34-2-L	CREW SR (3)	10	0.100	303	14	14	14	303	303	303
01-34-3-L	CREW SR (3)	10	0.100	309	13	13	13	309	309	309
01-44-2-L	CREW SR (3)	10	0.100	294	14	14	14	294	294	294
01-47-1-L	CREW SR (3)	10	0.100	265	20	20	20	265	265	265
01-57-2-L	PASSENGER BERTHING (6)	10	0.100	377	9	9	9	377	377	377
CUI=LL	**(Wardroom/Mess/Lounge Areas)**									
1-14-2-L	RECREATION ROOM	9	0.300	715	5	5	5	715	715	715
1-22-3-L	EXERCISE RM	16	0.001	755	12	12	12	755	755	755
1-34-1-L	WARDROOM	9	0.300	1133	3	3	3	1133	1133	1133
1-52-1-L	CREWS MESSROOM	9	0.300	1488	3	3	3	1488	1488	1488
01-61-0-L	TRAINING RM/ CREWS LOUNGE	9	0.300	939	3	3	3	939	939	939
CUI=LM	**(Medical/Dental Spaces)**									
1-30-1-L	HOSPITAL	8	0.700	720	2	2	2	720	720	720
CUI=LP	**(Passageway/Staircase/Vestibule)**									
3-72-1-L	TUNNEL	3	0.200	5499	2	2	2	4525	4525	25
2-24-0-L	PASSAGE	15	0.010	169	∞	∞	∞	169	169	169
2-86-1-L	TUNNEL	3	0.200	4888	1	1	1	4330	4330	1
1-9-0-L	PASSAGE	15	0.010	231	7	7	9	231	231	231
1-9-0A-L	PASSAGE	15	0.010	888	5	5	5	888	888	888
1-9-0B-L	PASSAGE	15	0.010	1366	6	6	6	1366	1366	1366
1-22-1-L	STWY	14	0.010	266	11	11	15	266	266	266
2-22-1-L	STWY	14	0.010	133	5	5	6	133	133	0
1-68-1-L	STWY	14	0.010	156	18	18	21	156	156	156
1-72-2-L	VESTIBULE	15	0.010	96	1	1	1	96	96	0
01-2-0-L	PASSAGE	15	0.010	116	7	8	11	116	116	116
01-10-0-L	PASSAGE	15	0.010	199	5	7	13	199	199	199
01-10-0A-L	PASSAGE	15	0.010	752	5	5	5	752	752	752
01-10-0B-L	PASSAGE	15	0.010	1122	6	6	6	1122	1122	1122
01-22-1-L	STAIRWAY	14	0.010	278	11	11	15	278	278	1
01-54-2-L	VESTIBULE	15	0.010	201	5	5	5	201	201	201
01-61-2-L	PASSAGE	15	0.010	201	5	5	5	201	201	201
02-20-0-L	PASSAGE	15	0.010	1308	6	6	6	1308	1308	1308
02-25-1-L	STAIRWAY	14	0.010	266	6	6	6	266	266	266

Table B.8.1 Fire Growth Models, Rates, and FRI Times (continued)

Plan ID	Compartment Name	Growth Model	Alpha kW/sec^2	Max Q kW	FRI X	Time Y	(Min.) Z	Post- X	FRI Q Y	(kW) Z
CUI=LW	**(Sanitary Spaces)**									
1-28-4-L	T/S	11	1.000	4480	1	1	1	330	330	330
1-32-1-L	T/S	11	1.000	4167	1	1	1	202	202	202
1-48-2-L	T/S	11	1.000	4930	1	1	1	202	202	202
1-57-2-L	T/S	11	1.000	4654	1	1	1	330	330	330
1-66-2-L	T/S	11	1.000	4824	1	1	1	330	330	330
01-14-2-L	T/S	11	1.000	5015	1	1	1	198	198	198
01-17-1-L	T/S	11	1.000	4808	1	1	1	330	330	330
01-26-2-L	T/S	11	1.000	4627	1	1	1	330	330	330
01-27-1-L	T/S	11	1.000	5005	1	1	1	330	330	330
01-34-1-L	T/S	11	1.000	5005	1	1	1	198	198	198
01-41-2-L	T/S	11	1.000	4538	1	1	1	330	330	330
01-46-1-L	T/S	11	1.000	4147	1	1	1	198	198	198
01-54-6-L	T/S	11	1.000	5647	1	1	1	198	198	198
02-14-1-L	T/S	11	1.000	4591	1	1	1	211	211	211
02-18-2-L	T/S	11	1.000	4159	1	1	1	211	211	211
02-27-2-L	T/S	11	1.000	4233	1	1	1	211	211	211
02-33-1-L	T/S	11	1.000	4419	1	1	1	211	211	211
02-33-2-L	T/S	11	1.000	4899	1	1	1	211	211	211
02-36-1-L	T/S	11	1.000	5485	1	1	1	211	211	211
02-41-2-L	T/S	11	1.000	5106	1	1	1	211	211	211
03-28-1-L	TOILET	16	0.001	4	1	1	1	4	4	4
CUI=QA	**(Aux Machinery Spaces)**									
2-24-4-Q	A/C MCHRY SPACE	13	0.200	124560	2	2	2	2873	2873	729
2-29-1-Q	SEWAGE MCHRY RM	13	0.200	29938	2	2	2	2194	2194	69
2-94-0-Q	STEERING GEAR RM	13	0.200	87440	2	2	2	3571	2759	718
01-69-1-Q	HYD. POWER RM.	13	0.200	46724	2	2	2	2230	2230	234
02-32-2-Q	HW HTR LKR	5	0.100	39	6	6	6	39	39	39
CUI=QE	**(Emergency Aux Generator Spaces)**									
01-6-0-Q	EMER SWBD & GEN RM	13	0.200	202904	2	2	2	7267	7267	2182
CUI=QF	**(Fan Room)**									
1-34-2-Q	FAN ROOM	13	0.200	41832	2	2	2	2694	2694	2694
1-68-3-Q	FAN ROOM	5	0.100	753	8	8	8	420	420	420
1A-14-0-Q	MAIN DK UTILITY SPACE NO.2	5	0.400	2121	4	4	4	2121	2121	2121
1A-14-1-Q	MAIN DK UTILITY SPACE NO.1	5	0.400	499	8	8	8	499	499	499
1A-34-1-Q	MAIN DK UTILITY SPACE NO.3	5	0.400	566	5	5	5	566	566	566
1A-34-2-Q	MAIN DK UTILITY SPACE NO.4	5	0.400	2357	4	4	4	2357	2357	2357
1A-42-1-Q	MAIN DK UTILITY SPACE NO.5	5	0.400	478	5	5	5	478	478	478
1A-52-1-Q	MAIN DK UTILITY SPACE NO.7	5	0.400	744	4	4	4	744	744	744
01A-14-1-Q	FCSLE DK UTILITY SPACE NO.1	5	0.400	1096	5	5	5	1095	1095	1095
01A-14-2-Q	FCSLE DK UTILITY SPACE NO.2	5	0.400	1184	4	4	4	1184	1184	1184
01A-34-0-Q	FCSLE DK UTILITY SPACE NO.4	5	0.400	1098	5	5	5	1098	1098	1098
01A-34-1-Q	FCSLE DK UTILITY SPACE NO.3	5	0.400	946	7	7	7	946	946	946
01A-54-1-Q	FCSLE DK UTILITY SPACE NO.5	5	0.400	811	7	7	7	811	811	811
01A-54-2-Q	FCSLE DK UTILITY SPACE NO.6	5	0.400	884	4	4	4	884	884	884
02-42-1-Q	FAN RM	13	0.200	4320	2	2	2	946	946	946
02A-14-0-Q	UPPER DK UTILITY SPACE NO.1	5	0.400	3036	4	4	4	3036	3036	3036
02A-22-1-Q	UPPER DK UTILITY SPACE NO.2	5	0.400	345	5	5	5	345	345	345
CUI=QG	**(Galley/Pantry/Scullery)**									
1-42-1-Q	GALLEY	13	0.200	106526	2	2	2	362	362	362
1-44-2-Q	SCULLERY	13	0.200	20684	1	1	1	2096	2096	128

Table B.8.1 Fire Growth Models, Rates, and FRI Times (continued)

Plan ID	Compartment Name	Growth Model	Alpha kW/sec²	Max Q kW	FRI X	Time Y	(Min.) Z	Post- X	FRI Q Y	(kW) Z
CUI=QL	**(Laundry)**									
2-24-1-Q	LAUNDRY RM	12	0.100	17400	3	3	3	3817	3817	3817
2-24-1A-Q	LAUNDRY RM	5	0.100	54	8	8	8	54	54	54
CUI=QO	**(Office Spaces)**									
1-6-4-Q	SHIP STORE	6	0.010	74773	5	5	5	315	315	315
02-22-1-Q	SHIP'S OFFICE & SUPPLY	8	0.700	888	2	2	2	888	888	888
CUI=QS	**(Shops)**									
1-62-3-Q	GENERAL WORKSHOP	13	0.200	67407	2	2	2	222	222	222
1-75-0-Q	D.C. SHOP	5	0.400	632	21	21	21	632	632	85
01-68-0-Q	ELECTRONICS SHOP	7	0.010	12889	6	6	6	6078	6078	1584
CUI=TH	**(Trunks/Hoists/Dumbwaiters)**									
4-24-1-T	SPEED LOG XDCR TRUNK	16	0.001	32	∞	∞	∞	0	0	0
4-31-1-T	TRANSDUCER TRUNK	16	0.001	16	∞	∞	∞	0	0	0
1-46-1-T	MCHRY ACCESS TRUNK	14	0.010	120	∞	∞	∞	120	120	120
01-34-2A-T	VENT TRUNK	16	0.001	10	∞	∞	∞	10	10	10
CUI=TU	**(Stacks/Engine Uptakes)**									
1-40-1-T	UPTAKE	13	0.200	11995	2	2	2	11995	11995	11995
1-40-4-T	UPTAKE	13	0.200	11995	2	2	2	11995	11995	11995
CUI=V	**(Voids/Cofferdams)**									
4-34-1-V	VOID	16	0.001	23	∞	∞	∞	1	1	1
4-34-2-V	VOID	16	0.001	23	∞	∞	∞	1	1	1
CUI=W	**(Water Tank (empty))**									
4-B-0-W	FOREPEAK BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
4-6-1-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
4-6-2-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
4-24-2-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
4-24-3-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
4-24-4-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
3-52-02-W	POTABLE WATER	16	0.001	0	∞	∞	∞	0	0	0
3-58-0-W	AUXILARY POTABLE WATER	16	0.001	0	∞	∞	∞	0	0	0
4-86-1-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
4-86-2-W	BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
2-31-1-W	SEWAGE HOLDING TANK	16	0.001	0	∞	∞	∞	0	0	0
2-72-0-W	ANTI-ROLL TANK	16	0.001	0	∞	∞	∞	0	0	0
3-94-1-W	AFTER PEAK BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0
3-94-2-W	AFTER PEAK BALLAST TANK	16	0.001	0	∞	∞	∞	0	0	0

APPENDIX B

REFERENCES

A. U.S.C.G. Drawing 225 WMEC-601-004/005/006 "General Arrangement, Main Deck, Focsle Deck and Upper Deck".

B. Military Sealift Command Drawing T-AGOS-10-835-5988704/5988705 "Inboard and Outboard Profiles".

C. U.S.C.G. Drawing SK-601-001/002/003 "Conceptual Design Modifications, Main Deck, Focsle Deck, and Upper Deck".

D. Naval Ships' Technical Manual, NAVSEA 0901-LP-079-0010, Chapter 079, Volume 2, "Damage Control - Practical Damage Control," Author/Sponsor: Naval Sea Systems Command, 15 August 1976.

E. Sprague, Chester M., "Theoretical Basis of the Ship Fire Safety Engineering Methodology," Technical Note 058, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, February, 1992.

F. Clouthier, Elizabeth; Rich, Doris; and Romberg, Betty, "SAFE User Manual Version 2.2, A Computer Model for the Implementation of The Ship Fire Safety Engineering Methodology", Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, June 1995.

G. Military Sealift Command Drawing 111-0000007 Rev F "224 FT T-AGOS Class Vessel Shell Expansion".

H. Military Sealift Command Drawing 122-0000014 SHTS 1-4 "Transverse Bulkheads".

I. Holmstedt, Herbert A., "Fire Safety Analysis of Six Small Coast Guard Cutter Classes," 7 Volume Technical Report, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, September, 1993.

J. Sprague, Chester M., "Fire Safety Analysis of Three Small Coast Guard Cutter Classes," 4 Volume Interim Technical Report, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, July, 1992.

K. Holmstedt, Herbert A., Romberg, Betty H., and Sprague, Chester M., "Preliminary Results, Baseline Fire Safety Analysis, CG Cutter VINDICATOR (WMEC 3)", CompuCon, Interim Report, Prepared for the U.S. Coast Guard Research and Development Center, Marine Fire and Safety Research Branch, 1082 Shennecossett Road, Groton, CT 06340-6096, November, 1994.

L. Butler, F. and Kaysen, H. D., Gibbs and Cox, Inc., New York, New York, "PHM-Passive Fire Protection Study," Prepared for Naval Ship Engineering Center, Hyattsville, MD, September 15, 1975.

M. "Naval Surface Ships," Prepared for Naval Ship Engineering Center, Hyattsville, MD, June 28, 1978.

Appendix C

USCGC VINDICATOR FIRE SAFETY ANALYSIS RESULTS

C.1 Preliminary Baseline Fire Safety Analysis Results

C.2 Baseline Fire Safety Analysis Results

C.3 Analysis of Alternatives Results

The detailed results of the fire safety analysis of the U.S. Coast Guard Cutter VINDICATOR (WMEC 3) are tabulated in this appendix. Results are organized into three sections. C.1 presents the preliminary baseline fire safety analysis results submitted to U.S. Coast Guard Headquarters on 11/26/94. C.2 includes complete results of the baseline fire safety analysis. C.3 presents the results of the analysis of four alternatives studied in conjunction with the fire safety analysis of the VINDICATOR.

The following is an index of the various tables of results contained in this Appendix:

C.1 USCGC VINDICATOR FIRE SAFETY ANALYSIS RESULTS

Table C.1.1. Preliminary Baseline, Standard Scenarios, Target Option

		Run No.	**2-19**	**2-27**	**2-23**
		Scenario	**1**	**2**	**3**
		Configuration	**XRAY**	**YOKE**	**YOKE**
		Location	**In Port**	**In Port**	**At Sea**
		Fire Prot Level	**I,A,M**	**I,A,M**	**I,A,M**
Plan ID	**Compartment Name**	**CUI**	**RLF**	**RLF**	**RLF**
1-42-1-Q	GALLEY	QG	0.28	0.28	0.28
1-44-2-Q	SCULLERY	QG	0.27	0.27	0.27
1-52-1-L	CREWS MESSROOM	LL	0.27	0.27	0.27
03-15-0-C	PILOT HOUSE	C	0.25	0.25	0.25
3-34-0-E	MAIN GENERATOR RM	EM	0.23	0.23	0.23
1-34-2-Q	FAN ROOM	QF	0.19	0.19	0.19
2-52-0-C	MAIN CONTROL STATION	C	0.15	0.15	0.15
1-40-4-T	UPTAKE	TU	0.15	0.15	0.15
2-24-4-Q	A/C MCHRY SPACE	QA	0.14	0.14	0.14
1-40-1-T	UPTAKE	TU	0.14	0.14	0.14
2-29-1-Q	SEWAGE MCHRY RM	QA	0.10	0.10	0.10
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.09	0.09	0.09
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.08	0.08
2-94-0-Q	STEERING GEAR RM	QA	0.05	0.05	0.05
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.03	0.03
01-54-1-C	COMMUNICATION CTR	C	0.03	0.03	0.03
1A-34-2-Q	MAIN DECK UTILITY SPACE NO. 4	QF	0.02	0.02	0.02
2-86-1-L	TUNNEL	LP	0.02	0.02	0.02
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02	0.02
3-72-1-L	TUNNEL	LP	0.02	0.02	0.02
01-G-0-A	BOSUN STORES	AS	0.02	0.02	0.02
01-2-1-A	STRM NO 1	AS	0.01	0.01	0.01
1A-14-1-Q	MAIN DECK UTILITY SPACE NO. 1	QF	0.01	0.01	0.01
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.01	0.01	0.01

Notes: Results shown for every compartment with MAL = 1, 2 or 3 and with RLF > 0.00

Table C.1.2. Preliminary Baseline, Non-Standard Scenarios, XRAY, In Port, Target Option

		Run No.	2-19	2-20	2-21	2-22
		Scenario	1	4	7	10
		Configuration	XRAY	XRAY	XRAY	XRAY
		Location	In Port	In Port	In Port	In Port
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	Compartment Name	CUI				
1-42-1-Q	GALLEY	QG	0.28	0.52	0.88	1.63
1-44-2-Q	SCULLERY	QG	0.27	0.61	0.63	1.36
1-52-1-L	CREWS MESSROOM	LL	0.27	1.17	0.90	3.59
03-15-0-C	PILOT HOUSE	C	0.25	0.88	0.65	2.16
3-34-0-E	MAIN GENERATOR RM	EM	0.23	0.35	0.60	0.86
1-34-2-Q	FAN ROOM	QF	0.19	0.49	0.49	1.24
2-52-0-C	MAIN CONTROL STATION	C	0.15	0.27	0.38	0.66
1-40-4-T	UPTAKE	TU	0.15	0.24	0.34	0.52
2-24-4-Q	A/C MCHRY SPACE	QA	0.14	0.25	0.34	0.57
1-40-1-T	UPTAKE	TU	0.14	0.22	0.33	0.51
02-42-1-Q	FAN RM	QF	0.13	0.33	0.32	0.77
2-29-1-Q	SEWAGE MCHRY RM	QA	0.10	0.14	0.20	0.28
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.09	0.11	0.30	0.35
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.19	0.32	0.80
2-94-0-Q	STEERING GEAR RM	QA	0.05	0.06	0.06	0.09
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.07	0.14	0.28
01-54-1-C	COMMUNICATION CTR	C	0.03	0.04	0.04	0.07
1A-34-2-Q	MAIN DECK UTILITY SPACE NO. 4	QF	0.02	0.06	0.10	0.26
2-86-1-L	TUNNEL	LP	0.02	0.03	0.03	0.06
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02	0.07	0.08
3-72-1-L	TUNNEL	LP	0.02	0.03	0.04	0.06
01-G-0-A	BOSUN STORES	AS	0.02	0.04	0.02	0.05
01-2-1-A	STRM NO 1	AS	0.01	0.03	0.01	0.04
1A-14-1-Q	MAIN DECK UTILITY SPACE NO. 1	QF	0.00	0.01	0.00	0.01
01-68-0-Q	ELECT. & ELECTRICAL SHOP	QS	0.00	0.00	0.03	0.04

Notes: Results shown for every compartment with MAL = 1, 2 or 3 and with RLF > 0.00

C.2 Baseline Fire Safety Analysis Results

Table C.2.1. Baseline, All Scenarios, Target Option, XRAY, In Port

		Run No.	3-28	3-29	3-30	3-31
		Scenario	1	4	7	10
		Configuration	XRAY	XRAY	XRAY	XRAY
		Location	In Port	In Port	In Port	In Port
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	Compartment Name	CUI	RLF	RLF	RLF	RLF
1-34-2-Q	FAN ROOM	QF	0.22	0.47	0.55	1.15
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.35	0.56	0.83
1-44-2-Q	SCULLERY	QG	0.19	0.37	0.43	0.79
02-42-1-Q	FAN RM	QF	0.18	0.40	0.38	0.74
1-40-4-T	UPTAKE	TU	0.17	0.26	0.35	0.51
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.26	0.34	0.61
1-40-1-T	UPTAKE	TU	0.13	0.21	0.32	0.48
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.21	0.29	0.49
1-52-1-L	CREWS MESSROOM	LL	0.13	0.38	0.43	1.10
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.13	0.36	0.40
1-42-1-Q	GALLEY	QG	0.10	0.17	0.64	1.13
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.19	0.34	0.80
2-29-1-Q	SEWAGE MCHRY RM	QA	0.08	0.11	0.16	0.21
03-15-0-C	PILOT HOUSE	C	0.05	0.28	0.20	1.05
2-94-0-Q	STEERING GEAR RM	QA	0.04	0.05	0.05	0.07
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.08	0.13	0.29
01-54-1-C	COMMUNICATION CTR	C	0.03	0.13	0.04	0.98
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.02	0.05	0.09	0.22
2-86-1-L	TUNNEL	LP	0.02	0.03	0.03	0.04
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02	0.05	0.07
01-G-0-A	BOSUN STORES	AS	0.02	0.04	0.03	0.08
01-2-1-A	STRM NO 1	AS	0.02	0.05	0.02	0.16
3-72-1-L	TUNNEL	LP	0.02	0.02	0.03	0.05
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.01	0.02	0.03	0.05
2-24-1-Q	LAUNDRY RM	QL	0.00	0.01	0.00	0.01

Notes: Results shown for every compartment with MAL = 1, 2 or 3 and with RLF > 0.00

Table C.2.2. Baseline, All Scenarios, Target Option, YOKE, In Port

Plan ID	Compartment Name	Run No.	3-32	3-33	3-34	3-35
		Scenario	2	5	8	12
		Configuration	YOKE	YOKE	YOKE	YOKE
		Location	In Port	In Port	In Port	At Sea
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	Compartment Name	CUI				
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.01	0.02	0.03	0.05
01-64-2-K	ARMORY/LAW ENFORCEMENT CENTER	K		0.00	0.00	0.00
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	QO	0.00	0.00	0.00	0.00
1-34-2-Q	FAN ROOM	QF	0.22	0.47	0.55	1.16
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.35	0.56	0.86
1-44-2-Q	SCULLERY	QG	0.19	0.37	0.43	0.82
02-42-1-Q	FAN RM	QF	0.18	0.40	0.38	0.76
1-40-4-T	UPTAKE	TU	0.17	0.26	0.35	0.54
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.26	0.34	0.61
1-40-1-T	UPTAKE	TU	0.13	0.21	0.32	0.49
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.21	0.29	0.50
1-52-1-L	CREWS MESSROOM	LL	0.13	0.38	0.43	1.10
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.13	0.36	0.40
1-42-1-Q	GALLEY	QG	0.10	0.17	0.64	1.14
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.19	0.33	0.79
2-29-1-Q	SEWAGE MCHRY RM	QA	0.08	0.11	0.16	0.21
03-15-0-C	PILOT HOUSE	C	0.05	0.28	0.20	1.07
2-94-0-Q	STEERING GEAR RM	QA	0.04	0.05	0.05	0.07
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.08	0.13	0.31
01-54-1-C	COMMUNICATION CTR	C	0.03	0.13	0.04	0.98
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.02	0.05	0.09	0.22
2-86-1-L	TUNNEL	LP	0.02	0.03	0.03	0.04
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02	0.05	0.07
01-G-0-A	BOSUN STORES	AS	0.02	0.04	0.03	0.08
01-2-1-A	STRM NO 1	AS	0.02	0.05	0.02	0.16
3-72-1-L	TUNNEL	LP	0.02	0.02	0.03	0.05

Notes: Results shown for every compartment with MAL = 1, 2 or 3 and with RLF > 0.00

Table C.2.3. Baseline, All Scenarios, Target Option, YOKE, At Sea

		Run No.	3-36	3-37	3-38	3-39
		Scenario	3	6	9	12
		Configuration	YOKE	YOKE	YOKE	YOKE
		Location	At Sea	At Sea	At Sea	At Sea
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	**Compartment Name**	**CUI**				
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.01	0.01	0.03	0.05
01-64-2-K	ARMORY/LAW ENFORCEMENT CTR	K		0.00	0.00	0.00
02-22-1-Q	SHIP'S OFFICE & SUPPLY OFFICE	QO	0.00	0.00	0.00	0.00
1-34-2-Q	FAN ROOM	QF	0.23	0.48	0.55	1.16
3-34-0-E	MAIN GENERATOR RM	EM	0.23	0.36	0.57	0.86
1-44-2-Q	SCULLERY	QG	0.20	0.39	0.43	0.82
02-42-1-Q	FAN RM	QF	0.18	0.42	0.39	0.76
1-40-4-T	UPTAKE	TU	0.18	0.29	0.35	0.54
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.26	0.34	0.61
1-40-1-T	UPTAKE	TU	0.14	0.22	0.33	0.49
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.22	0.29	0.50
1-52-1-L	CREWS MESSROOM	LL	0.13	0.38	0.43	1.10
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.13	0.36	0.40
1-42-1-Q	GALLEY	QG	0.10	0.17	0.64	1.14
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.19	0.33	0.79
2-29-1-Q	SEWAGE MCHRY RM	QA	0.08	0.11	0.16	0.21
03-15-0-C	PILOT HOUSE	C	0.05	0.29	0.20	1.07
2-94-0-Q	STEERING GEAR RM	QA	0.04	0.05	0.05	0.07
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.08	0.14	0.31
01-54-1-C	COMMUNICATION CTR	C	0.03	0.13	0.04	0.98
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.02	0.05	0.09	0.22
2-86-1-L	TUNNEL	LP	0.02	0.02	0.03	0.04
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02	0.05	0.07
01-G-0-A	BOSUN STORES	AS	0.02	0.04	0.03	0.08
01-2-1-A	STRM NO 1	AS	0.02	0.05	0.02	0.16
3-72-1-L	TUNNEL	LP	0.02	0.02	0.03	0.05
2-24-1-Q	LAUNDRY RM	QL	0.00	0.01	0.00	0.01
1A-14-1-Q	MAIN DECK UTILITY SPACE NO.1	QF	0.00	0.01	0.01	0.02

Notes: Results shown for every compartment with MAL = 1, 2 or 3 and with RLF > 0.00

Table C.2.4. Baseline, Standard Scenario, Barrier Option, XRAY, In Port

ROOM OF ORIGIN BARRIER OPTION - DETAIL LEVEL REPORT (PAGES 1-5 ONLY)
LISTING OF MOST PROBABLE ROOM OF ORIGIN BARRIER FAILURES

Model Run: 3-67
Configuration: XRAY
Location: In Port
Fire Protection Level: Passive, Automatic, and Manual
Run Time: 60 minutes

Ordered by Relative Loss Frequency of Adjacent Room|FFS in Room of Origin at Time of Barrier Failure

---------Room of Origin--------   -----Barrier to Adjacent Room-----

Plan ID	FRI Time	RLF-FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RLF - FFS (x 1000)	Opening/ Zero-Str
2-6-0-E	2	4.60	1-9-0-L	2	4.60	Opening
3-34-0-E	3	3.72	2-52-0-C	3	3.72	Opening
3-34-0-E	3	3.72	1-46-1-T	3	3.72	Zero-str
3-34-0-E	3	3.72	1-40-4-T	3	3.72	Zero-str
3-34-0-E	3	3.72	1-40-1-T	3	3.72	Zero-str
3-34-0-E	3	3.72	2-24-0-L	3	3.72	Opening
01-6-0-Q	2	2.79	01-10-0-L	2	2.79	Opening
01-6-0-Q	2	2.79	01-2-0-L	2	2.79	Opening
2-24-1-Q	3	1.89	2-24-1A-Q	3	1.89	Zero-str
2-24-1A-Q	8	1.89	2-24-1-Q	8	1.89	Zero-str
3-34-0-E	3	3.72	1-44-2-Q	6	1.44	
2-24-4-Q	2	1.31	2-24-0-L	2	1.31	Opening
2-29-1-Q	2	1.31	2-24-0-L	2	1.31	Opening
2-94-0-Q	2	1.31	2-86-1-L	2	1.31	Opening
2-94-0-Q	2	1.31	ext. ovrhd.	2	1.31	Opening
1-40-1-T	2	0.83	3-34-0-E	2	0.83	Zero-str
1-40-4-T	2	0.83	3-34-0-E	2	0.83	Zero-str
3-34-0-E	3	3.72	2-29-1-Q	3	0.76	
02-32-2-Q	6	0.73	02A-14-0-Q	6	0.73	Zero-str
3-34-0-E	3	3.72	1-48-2-L	6	0.70	
3-34-0-E	3	3.72	1-45-2-L	6	0.70	
3-34-0-E	3	3.72	1-42-1-Q	6	0.70	
3-34-0-E	3	3.72	1-40-2-A	6	0.70	
3-34-0-E	3	3.72	1-34-2-Q	6	0.70	
3-34-0-E	3	3.72	1-34-1-L	6	0.70	
3-34-0-E	3	3.72	1-9-0B-L	6	0.70	
3-34-0-E	3	3.72	2-24-4-Q	6	0.70	
3-34-0-E	3	3.72	3-52-02-W	6	0.70	
3-34-0-E	3	3.72	4-24-4-W	6	0.70	
3-34-0-E	3	3.72	4-24-3-W	6	0.70	

Table C.2.4. (continued)

Plan ID	FRI Time	RLF-FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RLF - FFS (x 1000)	Opening/ Zero-Str
3-34-0-E	3	3.72	4-24-2-W	6	0.70	
2-6-0-E	2	4.60	not analyzed	5	0.67	
2-6-0-E	2	4.60	not analyzed	5	0.67	
2-6-0-E	2	4.60	not analyzed	5	0.67	
2-6-0-E	2	4.60	4-B-0-W	5	0.67	
2-6-0-E	2	4.60	ext. blkhd.	5	0.67	
2-6-0-E	2	4.60	ext. blkhd.	5	0.67	
1-40-1-T	2	0.83	ext. ovrhd.	2	0.62	
1-40-4-T	2	0.83	ext. ovrhd.	2	0.62	
2-6-0-E	2	4.60	1-6-4-Q	14	0.59	
3-52-01-E	3	0.56	1-68-1-L	3	0.56	Zero-str
3-52-01-E	3	0.56	2-52-0-C	3	0.56	Opening
3-52-01-E	3	0.56	3-72-1-L	3	0.56	Opening
02-42-2-A	11	0.55	02A-14-0-Q	11	0.55	Zero-str
1-44-2-Q	1	0.54	1-9-0B-L	1	0.54	Opening
3-34-0-E	3	3.72	4-34-2-V	5	0.54	
3-34-0-E	3	3.72	4-34-1-V	5	0.54	
3-34-0-E	3	3.72	2-31-1-W	5	0.54	
3-34-0-E	3	3.72	4-34-2-V	5	0.54	
3-34-0-E	3	3.72	4-34-1-V	5	0.54	
2-6-0-E	2	4.60	1-6-3-A	14	0.53	
2-6-0-E	2	4.60	1-6-2-A	17	0.52	
2-6-0-E	2	4.60	1-6-1-A	17	0.52	
02-14-3-L	8	0.49	02-20-0-L	8	0.48	
02-14-3-L	8	0.49	02-14-1-L	8	0.48	
02-22-2-L	8	0.49	02-27-2-L	8	0.48	
02-22-2-L	8	0.49	02-20-0-L	8	0.48	
02-14-2-L	10	0.49	02-20-0-L	10	0.48	
02-14-2-L	10	0.49	02-18-2-L	10	0.48	
01-64-2-K	4	0.97	01-61-2-L	5	0.48	
01-30-1-L	7	0.46	01-27-1-L	7	0.46	
01-30-1-L	7	0.46	01-10-0A-L	7	0.46	
01-30-1-L	7	0.46	01-10-0A-L	7	0.46	
02-30-2-L	8	0.46	02-33-2-L	8	0.46	
02-30-2-L	8	0.46	02-20-0-L	8	0.46	
02-30-1-L	9	0.46	02-33-1-L	9	0.46	
02-30-1-L	9	0.46	02-20-0-L	9	0.46	
02-37-2-L	11	0.46	02-41-2-L	11	0.46	
02-37-2-L	11	0.46	02-20-0-L	11	0.46	
01-14-1-L	12	0.46	01-17-1-L	12	0.46	
01-14-1-L	12	0.46	01-10-0A-L	12	0.46	
01-19-1-L	8	0.46	01-17-1-L	8	0.46	
01-19-1-L	8	0.46	01-10-0A-L	8	0.46	
02-35-1-L	18	0.46	02-36-1-L	18	0.46	
02-35-1-L	18	0.46	02-20-0-L	18	0.46	
01-24-1-L	7	0.46	01-27-1-L	7	0.46	
01-24-1-L	7	0.46	01-10-0A-L	7	0.46	
01-21-2-L	8	0.46	01-26-2-L	8	0.46	
01-21-2-L	8	0.46	01-10-0A-L	8	0.46	

Table C.2.4. (continued)

Plan ID	FRI Time	RLF-FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RLF - FFS (x 1000)	Opening/ Zero-Str
01-14-4-L	13	0.46	01-14-2-L	13	0.46	
01-14-4-L	13	0.46	01-10-0A-L	13	0.46	
1-14-2-L	5	0.45	1-9-0A-L	5	0.45	
01-2-1-A	4	0.44	01-2-0-L	4	0.44	Opening
01-2-1-A	4	0.44	01-G-0-A	4	0.44	Zero-str
01-G-0-A	5	0.44	01-2-1-A	5	0.44	Zero-str
01-G-0-A	5	0.44	01-2-0-L	5	0.44	Opening
1-D-0-A	8	0.44	01-2-1-A	8	0.44	Opening
01-1-2-A	4	0.44	01-2-0-L	4	0.44	
01-40-1-A	4	0.44	01-10-0B-L	4	0.44	
01-69-1-Q	2	0.43	01-61-0-L	2	0.43	Opening
1-40-1-T	2	0.83	02-35-1-L	2	0.41	
1-40-1-T	2	0.83	02-35-1-L	2	0.41	
1-40-1-T	2	0.83	01-40-1-A	2	0.41	
1-40-1-T	2	0.83	01-34-3-L	2	0.41	
1-40-1-T	2	0.83	01-10-0B-L	2	0.41	
1-40-1-T	2	0.83	01-10-0B-L	2	0.41	
1-40-1-T	2	0.83	1-34-1-L	2	0.41	
1-40-1-T	2	0.83	1-34-1-L	2	0.41	
1-40-4-T	2	0.83	02-37-2-L	2	0.41	
1-40-4-T	2	0.83	02-37-2-L	2	0.41	
1-40-4-T	2	0.83	01-44-2-L	2	0.41	
1-40-4-T	2	0.83	01-44-2-L	2	0.41	
1-40-4-T	2	0.83	01-34-2-L	2	0.41	
1-40-4-T	2	0.83	01-34-2-L	2	0.41	
1-40-4-T	2	0.83	1-45-2-L	2	0.41	
01-6-0-Q	2	2.79	ext. blkhd.	8	0.40	
01-6-0-Q	2	2.79	ext. blkhd.	8	0.40	
01-6-0-Q	2	2.79	ext. blkhd.	8	0.40	
01-6-0-Q	2	2.79	ext. blkhd.	8	0.40	
01-61-0-L	3	0.39	01-69-1-Q	3	0.39	Opening
01-61-0-L	3	0.39	ext. blkhd.	3	0.39	Opening
1-34-1-L	3	0.39	1-9-0B-L	3	0.39	
1-52-1-L	3	0.39	1-9-0B-L	3	0.39	
01-61-0-L	3	0.39	01-61-2-L	3	0.39	
2-29-1-Q	2	1.31	3-34-0-E	3	0.39	
01-6-0-Q	2	2.79	ext. ovrhd.	9	0.35	
01-6-0-Q	2	2.79	01-10-0-L	5	0.35	
01-6-0-Q	2	2.79	01-10-0-L	5	0.35	
01-6-0-Q	2	2.79	01-10-0-L	5	0.35	
01-6-0-Q	2	2.79	01-10-0-L	5	0.35	
01-6-0-Q	2	2.79	01-10-0-L	5	0.35	
2-24-1-Q	3	1.89	2-24-0-L	5	0.31	
01-G-0-A	5	0.44	01-1-2-A	5	0.30	
01-G-0-A	5	0.44	01-1-2-A	5	0.30	
1-44-2-Q	1	0.54	1A-34-2-Q	1	0.30	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	02-42-1-Q	2	0.29	
1-40-1-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-1-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	

Table C.2.4. (continued)

Plan ID	FRI Time	RLF-FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RLF - FFS (x 1000)	Opening/ Zero-Str
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	02-42-1-Q	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	01A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	01A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	01A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	1A-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1A-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1-40-3-A	2	0.29	
1-40-1-T	2	0.83	1A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	1A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	1-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1-40-3-A	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-4-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	02-41-2-L	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	01A-34-0-Q	2	0.29	
1-40-4-T	2	0.83	01A-34-0-Q	2	0.29	
1-40-4-T	2	0.83	01A-34-0-Q	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	01-41-2-L	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	1-40-6-A	2	0.29	
1-40-4-T	2	0.83	1A-34-2-Q	2	0.29	
1-40-4-T	2	0.83	1A-34-2-Q	2	0.29	
1-40-4-T	2	0.83	1-34-2-Q	2	0.29	
1-40-4-T	2	0.83	1-44-2-Q	2	0.29	
1-40-4-T	2	0.83	1-40-6-A	2	0.29	
1-40-4-T	2	0.83	1-40-2-A	2	0.29	
1-40-4-T	2	0.83	1-34-2-Q	2	0.29	
03-15-0-C	4	0.27	ext. blkhd.	4	0.27	Opening
03-15-0-C	4	0.27	03-28-1-L	4	0.27	
03-15-0-C	4	0.27	ext. blkhd.	4	0.27	Opening
03-15-0-C	4	0.27	ext. blkhd.	4	0.27	Opening
03-15-0-C	4	0.27	02-25-1-L	4	0.27	Zero-str
01-68-0-Q	6	0.26	01-61-2-L	6	0.26	Opening
01-68-0-Q	6	0.26	ext. blkhd.	6	0.26	Opening
1-22-3-L	12	0.26	1-9-0A-L	12	0.26	
2-24-1A-Q	8	1.89	2-24-0-L	24	0.25	
2-24-1-Q	3	1.89	2-24-0-L	8	0.24	

Table C.2.4. (continued)

Plan ID	FRI Time	RLF-FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RLF - FFS (x 1000)	Opening/ Zero-Str
2-24-1-Q	3	1.89	2-29-1-Q	8	0.24	
2-24-1-Q	3	1.89	2-24-0-L	8	0.24	
2-29-1-Q	2	1.31	2-31-1-W	6	0.22	
2-29-1-Q	2	1.31	2-24-1-Q	6	0.22	
2-24-1-Q	3	1.89	1-30-1-L	9	0.22	
2-24-1-Q	3	1.89	1-22-3-L	9	0.22	
2-24-1-Q	3	1.89	1-9-0A-L	9	0.22	
2-24-1-Q	3	1.89	not analyze	9	0.22	
2-24-1-Q	3	1.89	not analyze	9	0.22	
2-24-1-Q	3	1.89	ext. blkhd.	9	0.22	
2-24-4-Q	2	1.31	3-34-0-E	8	0.22	
1-6-3-A	5	0.44	1-9-0-L	5	0.22	
1-58-2-L	12	0.44	1-57-2-L	12	0.22	
1-58-2-L	12	0.44	1-9-0B-L	12	0.22	
01-34-2-L	14	0.44	01-41-2-L	14	0.22	
01-34-2-L	14	0.44	01-41-2-L	14	0.22	
01-34-2-L	14	0.44	01-10-0B-L	14	0.22	
01-28-2-L	11	0.44	01-26-2-L	11	0.22	
01-28-2-L	11	0.44	01-10-0A-L	11	0.22	
1-24-2-L	12	0.44	1-28-4-L	12	0.22	
1-24-2-L	12	0.44	1-9-0A-L	12	0.22	
01-34-3-L	13	0.44	01-34-1-L	13	0.22	
01-34-3-L	13	0.44	01-34-1-L	13	0.22	
01-34-3-L	13	0.44	01-10-0B-L	13	0.22	
01-44-2-L	14	0.44	01-41-2-L	14	0.22	
01-44-2-L	14	0.44	01-10-0B-L	14	0.22	
1-30-2-L	20	0.44	1-28-4-L	20	0.22	
1-30-2-L	20	0.44	1-9-0A-L	20	0.22	
01-47-1-L	20	0.44	01-46-1-L	20	0.22	
01-47-1-L	20	0.44	01-10-0B-L	20	0.22	
1-54-2-L	12	0.44	1-57-2-L	12	0.22	
1-54-2-L	12	0.44	1-9-0B-L	12	0.22	
1-63-2-L	12	0.44	1-66-2-L	12	0.22	
1-63-2-L	12	0.44	1-9-0B-L	12	0.22	
1-45-2-L	13	0.44	1-48-2-L	13	0.22	
1-45-2-L	13	0.44	1-9-0B-L	13	0.22	
1-68-2-L	23	0.44	1-66-2-L	23	0.22	
1-68-2-L	23	0.44	1-9-0B-L	23	0.22	
1-6-4-Q	5	0.22	1-9-0-L	5	0.22	
2-94-0-Q	2	1.31	3-94-2-W	4	0.21	
2-94-0-Q	2	1.31	3-94-2-W	4	0.21	
2-94-0-Q	2	1.31	3-94-1-W	4	0.21	
2-94-0-Q	2	1.31	3-94-1-W	4	0.21	
2-24-1A-Q	8	1.89	2-24-2-A	37	0.21	
2-24-1A-Q	8	1.89	not analyzed	43	0.21	

Table C.2.5. Baseline, Non-Standard Scenario (I & M), Barrier Option, XRAY, In Port

ROOM OF ORIGIN BARRIER OPTION - DETAIL LEVEL REPORT (PAGES 1-5 ONLY)
LISTING OF MOST PROBABLE ROOM OF ORIGIN BARRIER FAILURES

Model Run: 3-59
Configuration: XRAY
Fire Protection Level: Passive and Manual
Location: In Port
Run Time: 60 minutes

Ordered by Relative Frequency of Loss|FFS in Room of Origin at Time of Barrier Failure

---------Room of Origin---- **-----Barrier to Adjacent Room-----**

	FRI	RFL|FFS at FRI	Adj Room	Fail	RFL|FFS	Opening
Plan ID	Time	(x 1000)	Plan ID	Time	(x 1000)	Zero-Str
2-6-0-E	2	13.95	1-9-0-L	2	13.95	Opening
3-34-0-E	3	12.40	2-52-0-C	3	12.40	Opening
3-34-0-E	3	12.40	1-46-1-T	3	12.40	Zero-str
3-34-0-E	3	12.40	1-40-4-T	3	12.40	Zero-str
3-34-0-E	3	12.40	1-40-1-T	3	12.40	Zero-str
3-34-0-E	3	12.40	2-24-0-L	3	12.40	Opening
01-6-0-Q	2	9.30	01-10-0-L	2	9.30	Opening
01-6-0-Q	2	9.30	01-2-0-L	2	9.30	Opening
3-34-0-E	3	12.40	1-44-2-Q	6	4.80	
3-34-0-E	3	12.40	2-29-1-Q	3	2.53	
3-34-0-E	3	12.40	1-48-2-L	6	2.35	
3-34-0-E	3	12.40	1-45-2-L	6	2.35	
3-34-0-E	3	12.40	1-42-1-Q	6	2.35	
3-34-0-E	3	12.40	1-40-2-A	6	2.35	
3-34-0-E	3	12.40	1-34-2-Q	6	2.35	
3-34-0-E	3	12.40	1-34-1-L	6	2.35	
3-34-0-E	3	12.40	1-9-0B-L	6	2.35	
3-34-0-E	3	12.40	2-24-4-Q	6	2.35	
3-34-0-E	3	12.40	3-52-02-W	6	2.35	
3-34-0-E	3	12.40	4-24-4-W	6	2.35	
3-34-0-E	3	12.40	4-24-3-W	6	2.35	
3-34-0-E	3	12.40	4-24-2-W	6	2.35	
2-6-0-E	2	13.95	not analyze	5	2.04	
2-6-0-E	2	13.95	not analyze	5	2.04	
2-6-0-E	2	13.95	not analyze	5	2.04	
2-6-0-E	2	13.95	4-B-0-W	5	2.04	
2-6-0-E	2	13.95	ext. blkhd.	5	2.04	
2-6-0-E	2	13.95	ext. blkhd.	5	2.04	
2-24-1-Q	3	1.89	2-24-1A-Q	3	1.89	Zero-str
2-24-1A-Q	8	1.89	2-24-1-Q	8	1.89	Zero-str
3-52-01-E	3	1.86	1-68-1-L	3	1.86	Zero-str

Table C.2.5. (continued)

Plan ID	FRI Time	RFL|FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RFL|FFS (x 1000)	Opening Zero-Str
3-52-01-E	3	1.86	2-52-0-C	3	1.86	Opening
3-52-01-E	3	1.86	3-72-1-L	3	1.86	Opening
3-34-0-E	3	12.40	4-34-2-V	5	1.80	
3-34-0-E	3	12.40	4-34-1-V	5	1.80	
3-34-0-E	3	12.40	2-31-1-W	5	1.80	
3-34-0-E	3	12.40	4-34-2-V	5	1.80	
3-34-0-E	3	12.40	4-34-1-V	5	1.80	
2-6-0-E	2	13.95	1-6-4-Q	14	1.80	
2-6-0-E	2	13.95	1-6-3-A	14	1.61	
2-6-0-E	2	13.95	1-6-2-A	17	1.56	
2-6-0-E	2	13.95	1-6-1-A	17	1.56	
01-6-0-Q	2	9.30	ext. blkhd.	8	1.35	
01-6-0-Q	2	9.30	ext. blkhd.	8	1.35	
01-6-0-Q	2	9.30	ext. blkhd.	8	1.35	
01-6-0-Q	2	9.30	ext. blkhd.	8	1.35	
2-24-4-Q	2	1.31	2-24-0-L	2	1.31	Opening
2-29-1-Q	2	1.31	2-24-0-L	2	1.31	Opening
2-94-0-Q	2	1.31	2-86-1-L	2	1.31	Opening
2-94-0-Q	2	1.31	ext. ovrhd.	2	1.31	Opening
01-69-1-Q	2	1.31	01-61-0-L	2	1.31	Opening
01-6-0-Q	2	9.30	ext. ovrhd.	9	1.17	
01-6-0-Q	2	9.30	01-10-0-L	5	1.17	
01-6-0-Q	2	9.30	01-10-0-L	5	1.17	
01-6-0-Q	2	9.30	01-10-0-L	5	1.17	
01-6-0-Q	2	9.30	01-10-0-L	5	1.17	
01-6-0-Q	2	9.30	01-10-0-L	5	1.17	
1-40-1-T	2	0.83	3-34-0-E	2	0.83	Zero-str
1-40-4-T	2	0.83	3-34-0-E	2	0.83	Zero-str
01-68-0-Q	6	0.79	01-61-2-L	6	0.79	Opening
01-68-0-Q	6	0.79	ext. blkhd.	6	0.79	Opening
02-32-2-Q	6	0.73	02A-14-0-Q	6	0.73	Zero-str
1-42-1-Q	2	0.63	1-9-0B-L	2	0.63	
1-40-1-T	2	0.83	ext. ovrhd.	2	0.62	
1-40-4-T	2	0.83	ext. ovrhd.	2	0.62	
02-42-2-A	11	0.55	02A-14-0-Q	11	0.55	Zero-str
1-44-2-Q	1	0.54	1-9-0B-L	1	0.54	Opening
02-14-3-L	8	0.49	02-20-0-L	8	0.48	
02-14-3-L	8	0.49	02-14-1-L	8	0.48	
02-22-2-L	8	0.49	02-27-2-L	8	0.48	
02-22-2-L	8	0.49	02-20-0-L	8	0.48	
02-14-2-L	10	0.49	02-20-0-L	10	0.48	
02-14-2-L	10	0.49	02-18-2-L	10	0.48	
01-64-2-K	4	0.97	01-61-2-L	5	0.48	
01-30-1-L	7	0.46	01-27-1-L	7	0.46	
01-30-1-L	7	0.46	01-10-0A-L	7	0.46	
01-30-1-L	7	0.46	01-10-0A-L	7	0.46	
02-30-2-L	8	0.46	02-33-2-L	8	0.46	
02-30-2-L	8	0.46	02-20-0-L	8	0.46	
02-30-1-L	9	0.46	02-33-1-L	9	0.46	

Table C.2.5. (continued)

Plan ID	FRI Time	RFL|FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RFL|FFS (x 1000)	Opening Zero-Str
02-30-1-L	9	0.46	02-20-0-L	9	0.46	
02-37-2-L	11	0.46	02-41-2-L	11	0.46	
02-37-2-L	11	0.46	02-20-0-L	11	0.46	
01-14-1-L	12	0.46	01-17-1-L	12	0.46	
01-14-1-L	12	0.46	01-10-0A-L	12	0.46	
01-19-1-L	8	0.46	01-17-1-L	8	0.46	
01-19-1-L	8	0.46	01-10-0A-L	8	0.46	
02-35-1-L	18	0.46	02-36-1-L	18	0.46	
02-35-1-L	18	0.46	02-20-0-L	18	0.46	
01-24-1-L	7	0.46	01-27-1-L	7	0.46	
01-24-1-L	7	0.46	01-10-0A-L	7	0.46	
01-21-2-L	8	0.46	01-26-2-L	8	0.46	
01-21-2-L	8	0.46	01-10-0A-L	8	0.46	
01-14-4-L	13	0.46	01-14-2-L	13	0.46	
01-14-4-L	13	0.46	01-10-0A-L	13	0.46	
1-14-2-L	5	0.45	1-9-0A-L	5	0.45	
01-2-1-A	4	0.44	01-2-0-L	4	0.44	Opening
01-2-1-A	4	0.44	01-G-0-A	4	0.44	Zero-str
01-G-0-A	5	0.44	01-2-1-A	5	0.44	Zero-str
01-G-0-A	5	0.44	01-2-0-L	5	0.44	Opening
1-D-0-A	8	0.44	01-2-1-A	8	0.44	Opening
01-1-2-A	4	0.44	01-2-0-L	4	0.44	
01-40-1-A	4	0.44	01-10-0B-L	4	0.44	
1-40-1-T	2	0.83	02-35-1-L	2	0.41	
1-40-1-T	2	0.83	02-35-1-L	2	0.41	
1-40-1-T	2	0.83	01-40-1-A	2	0.41	
1-40-1-T	2	0.83	01-34-3-L	2	0.41	
1-40-1-T	2	0.83	01-10-0B-L	2	0.41	
1-40-1-T	2	0.83	01-10-0B-L	2	0.41	
1-40-1-T	2	0.83	1-34-1-L	2	0.41	
1-40-1-T	2	0.83	1-34-1-L	2	0.41	
1-40-4-T	2	0.83	02-37-2-L	2	0.41	
1-40-4-T	2	0.83	02-37-2-L	2	0.41	
1-40-4-T	2	0.83	01-44-2-L	2	0.41	
1-40-4-T	2	0.83	01-44-2-L	2	0.41	
1-40-4-T	2	0.83	01-34-2-L	2	0.41	
1-40-4-T	2	0.83	01-34-2-L	2	0.41	
1-40-4-T	2	0.83	1-45-2-L	2	0.41	
01-61-0-L	3	0.39	01-69-1-Q	3	0.39	Opening
01-61-0-L	3	0.39	ext. blkhd.	3	0.39	Opening
1-34-1-L	3	0.39	1-9-0B-L	3	0.39	
1-52-1-L	3	0.39	1-9-0B-L	3	0.39	
01-61-0-L	3	0.39	01-61-2-L	3	0.39	
2-29-1-Q	2	1.31	3-34-0-E	3	0.39	
3-52-01-E	3	1.86	3-34-0-E	6	0.36	
3-52-01-E	3	1.86	3-34-0-E	6	0.36	
3-52-01-E	3	1.86	not analyze	4	0.36	
3-52-01-E	3	1.86	not analyze	4	0.36	
3-52-01-E	3	1.86	not analyze	4	0.36	
3-52-01-E	3	1.86	not analyze	4	0.36	
2-24-1-Q	3	1.89	2-24-0-L	5	0.31	
01-G-0-A	5	0.44	01-1-2-A	5	0.30	

Table C.2.5. (continued)

Plan ID	FRI Time	RFL|FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RFL|FFS (x 1000)	Opening Zero-Str
01-G-0-A	5	0.44	01-1-2-A	5	0.30	
1-44-2-Q	1	0.54	1A-34-2-Q	1	0.30	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	02-42-1-Q	2	0.29	
1-40-1-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-1-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	02-42-1-Q	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	01A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	01A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	01A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	ext. blkhd.	2	0.29	
1-40-1-T	2	0.83	1A-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1A-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1-40-3-A	2	0.29	
1-40-1-T	2	0.83	1A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	1A-34-1-Q	2	0.29	
1-40-1-T	2	0.83	1-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1-42-1-Q	2	0.29	
1-40-1-T	2	0.83	1-40-3-A	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-4-T	2	0.83	02A-14-0-Q	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	02-41-2-L	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	01A-34-0-Q	2	0.29	
1-40-4-T	2	0.83	01A-34-0-Q	2	0.29	
1-40-4-T	2	0.83	01A-34-0-Q	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	01-41-2-L	2	0.29	
1-40-4-T	2	0.83	ext. blkhd.	2	0.29	
1-40-4-T	2	0.83	1-40-6-A	2	0.29	
1-40-4-T	2	0.83	1A-34-2-Q	2	0.29	
1-40-4-T	2	0.83	1A-34-2-Q	2	0.29	
1-40-4-T	2	0.83	1-34-2-Q	2	0.29	
1-40-4-T	2	0.83	1-44-2-Q	2	0.29	
1-40-4-T	2	0.83	1-40-6-A	2	0.29	
1-40-4-T	2	0.83	1-40-2-A	2	0.29	
1-40-4-T	2	0.83	1-34-2-Q	2	0.29	
3-52-01-E	3	1.86	1-52-1-L	10	0.28	
3-52-01-E	3	1.86	1-9-0B-L	9	0.27	

Table C.2.5. (continued)

Plan ID	FRI Time	RFL|FFS at FRI (x 1000)	Adj Room Plan ID	Fail Time	RFL|FFS (x 1000)	Opening Zero-Str
03-15-0-C	4	0.27	ext. blkhd.	4	0.27	Opening
03-15-0-C	4	0.27	03-28-1-L	4	0.27	
03-15-0-C	4	0.27	ext. blkhd.	4	0.27	Opening
03-15-0-C	4	0.27	ext. blkhd.	4	0.27	Opening
03-15-0-C	4	0.27	02-25-1-L	4	0.27	Zero-str
3-52-01-E	3	1.86	2-52-0-C	7	0.26	
3-52-01-E	3	1.86	2-52-0-C	7	0.26	
1-22-3-L	12	0.26	1-9-0A-L	12	0.26	
2-24-1A-Q	8	1.89	2-24-0-L	24	0.25	
2-24-1-Q	3	1.89	2-24-0-L	8	0.24	
2-24-1-Q	3	1.89	2-29-1-Q	8	0.24	
2-24-1-Q	3	1.89	2-24-0-L	8	0.24	
3-52-01-E	3	1.86	not analyze	9	0.24	
3-52-01-E	3	1.86	not analyze	9	0.24	
3-52-01-E	3	1.86	not analyze	9	0.24	
3-52-01-E	3	1.86	not analyze	9	0.24	
3-52-01-E	3	1.86	3-58-0-W	9	0.24	
3-52-01-E	3	1.86	3-58-0-W	9	0.24	
3-52-01-E	3	1.86	3-58-0-W	9	0.24	
3-52-01-E	3	1.86	not analyze	9	0.24	
3-52-01-E	3	1.86	not analyze	9	0.24	
3-52-01-E	3	1.86	3-52-02-W	9	0.24	
3-52-01-E	3	1.86	3-52-02-W	9	0.24	
2-29-1-Q	2	1.31	2-31-1-W	6	0.22	
2-29-1-Q	2	1.31	2-24-1-Q	6	0.22	
2-24-1-Q	3	1.89	1-30-1-L	9	0.22	
2-24-1-Q	3	1.89	1-22-3-L	9	0.22	
2-24-1-Q	3	1.89	1-9-0A-L	9	0.22	
2-24-1-Q	3	1.89	not analyze	9	0.22	
2-24-1-Q	3	1.89	not analyze	9	0.22	
2-24-1-Q	3	1.89	ext. blkhd.	9	0.22	
2-24-4-Q	2	1.31	3-34-0-E	8	0.22	
1-6-3-A	5	0.44	1-9-0-L	5	0.22	
1-58-2-L	12	0.44	1-57-2-L	12	0.22	
1-58-2-L	12	0.44	1-9-0B-L	12	0.22	
01-34-2-L	14	0.44	01-41-2-L	14	0.22	
01-34-2-L	14	0.44	01-41-2-L	14	0.22	
01-34-2-L	14	0.44	01-10-0B-L	14	0.22	
01-28-2-L	11	0.44	01-26-2-L	11	0.22	
01-28-2-L	11	0.44	01-10-0A-L	11	0.22	
1-24-2-L	12	0.44	1-28-4-L	12	0.22	
1-24-2-L	12	0.44	1-9-0A-L	12	0.22	
01-34-3-L	13	0.44	01-34-1-L	13	0.22	
01-34-3-L	13	0.44	01-34-1-L	13	0.22	
01-34-3-L	13	0.44	01-10-0B-L	13	0.22	

C.3 Analysis of Alternatives Results

Table C.3.1. Eliminate Automated Halon 1301 Total Flooding Systems

		Run No.	3-30	3-34	3-38
		Scenario	7	8	9
		Configuration	XRAY	YOKE	YOKE
		Location	In Port	In Port	At Sea
		Fire Prot Level	I,M	I,M	I,M
Plan ID	Compartment Name	CUI	RLF	RLF	RLF
1-34-2-Q	FAN ROOM	QF	0.55	0.55	0.55
3-34-0-E	MAIN GENERATOR RM	EM	0.56	0.56	0.57
1-44-2-Q	SCULLERY	QG	0.43	0.43	0.43
02-42-1-Q	FAN RM	QF	0.38	0.38	0.39
1-40-4-T	UPTAKE	TU	0.35	0.35	0.35
2-52-0-C	MAIN CONTROL STATION	C	0.34	0.34	0.34
1-40-1-T	UPTAKE	TU	0.32	0.32	0.33
2-24-4-Q	A/C MCHRY SPACE	QA	0.29	0.29	0.29
1-52-1-L	CREWS MESSROOM	LL	0.43	0.43	0.43
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.36	0.36	0.36
1-42-1-Q	GALLEY	QG	0.64	0.64	0.64
01-6-0-Q	EMER SWBD & GEN RM	QE	0.34	0.33	0.33
2-29-1-Q	SEWAGE MCHRY RM	QA	0.16	0.16	0.16
03-15-0-C	PILOT HOUSE	C	0.20	0.20	0.20
2-94-0-Q	STEERING GEAR RM	QA	0.05	0.05	0.05
3-52-01-E	PROPULSION MTR RM	EE	0.13	0.13	0.14
01-54-1-C	COMMUNICATION CTR	C	0.04	0.04	0.04
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.09	0.09	0.09
2-86-1-L	TUNNEL	LP	0.03	0.03	0.03
01-69-1-Q	HYD. POWER RM.	QA	0.05	0.05	0.05
01-G-0-A	BOSUN STORES	AS	0.03	0.03	0.03
01-2-1-A	STRM NO 1	AS	0.02	0.02	0.02
3-72-1-L	TUNNEL	LP	0.03	0.03	0.03
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.03	0.03	0.03

Notes: Results shown for every compartment with MAL = 1,2 or 3 and RLF > 0.00

Table C.3.2. Involvement of Fiberglass Toilet/Shower Units in Fires

Baseline amended to include Toilet/Showers (T/S)

		Run No.	54	55	56	57
		Scenario	1	4	7	10
		Configuration	XRAY	XRAY	XRAY	XRAY
		Location	In Port	In Port	In Port	In Port
		Fire Prot Level	I,A,M	I,A	I,M	I
Plan ID	Compartment Name	CUI	RLF	RLF	RLF	RLF
1-34-2-Q	FAN ROOM	QF	0.22	0.47	0.55	1.34
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.35	0.56	0.83
01-54-6-L	T/S	LW	0.20	0.68	0.65	2.14
02-41-2-L	T/S	LW	0.20	0.48	0.46	1.06
1-44-2-Q	SCULLERY	QG	0.19	0.37	0.43	0.81
02-42-1-Q	FAN RM	QF	0.18	0.40	0.38	0.80
1-48-2-L	T/S	LW	0.17	0.37	0.45	0.95
1-40-4-T	UPTAKE	TU	0.17	0.26	0.35	0.51
02-33-2-L	T/S	LW	0.16	0.55	0.39	1.55
01-41-2-L	T/S	LW	0.15	0.36	0.39	0.86
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.26	0.34	0.61
02-36-1-L	T/S	LW	0.13	0.43	0.34	1.15
1-40-1-T	UPTAKE	TU	0.13	0.21	0.32	0.48
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.21	0.29	0.49
1-52-1-L	CREWS MESSROOM	LL	0.13	0.38	0.43	1.22
02-33-1-L	T/S	LW	0.13	0.47	0.38	1.44
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.13	0.36	0.40
1-42-1-Q	GALLEY	QG	0.10	0.17	0.64	1.17
01-26-2-L	T/S	LW	0.10	0.41	0.30	1.24
01-27-1-L	T/S	LW	0.10	0.40	0.30	1.24
01-14-2-L	T/S	LW	0.10	0.41	0.31	1.33
01-34-1-L	T/S	LW	0.09	0.24	0.24	0.64
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.19	0.34	0.86
2-29-1-Q	SEWAGE MCHRY RM	QA	0.08	0.11	0.16	0.21
01-46-1-L	T/S	LW	0.07	0.42	0.29	1.58
1-32-1-L	T/S	LW	0.06	0.18	0.12	0.35
1-28-4-L	T/S	LW	0.06	0.14	0.14	0.38
03-15-0-C	PILOT HOUSE	C	0.05	0.28	0.20	1.12
1-57-2-L	T/S	LW	0.05	0.12	0.11	0.28
02-27-2-L	T/S	LW	0.04	0.23	0.13	0.89
2-94-0-Q	STEERING GEAR RM	QA	0.04	0.05	0.05	0.07
02-14-1-L	T/S	LW	0.04	0.18	0.13	0.61
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.08	0.13	0.33
02-18-2-L	T/S	LW	0.03	0.14	0.08	0.40
01-54-1-C	COMMUNICATION CTR	C	0.03	0.13	0.04	1.19
1-66-2-L	T/S	LW	0.02	0.06	0.05	0.14
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.02	0.05	0.09	0.23
01-17-1-L	T/S	LW	0.02	0.12	0.06	0.43
2-86-1-L	TUNNEL	LP	0.02	0.03	0.03	0.05
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02	0.05	0.07
01-G-0-A	BOSUN STORES	AS	0.02	0.04	0.03	0.08
01-2-1-A	STRM NO 1	AS	0.02	0.05	0.02	0.17
3-72-1-L	TUNNEL	LP	0.02	0.02	0.03	0.06
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.01	0.02	0.03	0.05

Notes: Results shown for every compartment with MAL = 1,2 or 3 and RLF > 0.00

Table C.3.3. In-Storage Scenario Compared to Baseline

		Run No.	3-31 Baseline	6-64 In-Storage
		Scenario	10	10
		Configuration	XRAY	XRAY
		Location	In Port	In Port
		Fire Prot Level	I	I
Plan ID	**Compartment Name**	**CUI**	**RLF**	**RLF**
1-34-2-Q	FAN ROOM	QF	1.15	0.03
3-34-0-E	MAIN GENERATOR RM	EM	0.83	0.03
1-44-2-Q	SCULLERY	QG	0.79	0.04
02-42-1-Q	FAN RM	QF	0.74	0.05
1-40-4-T	UPTAKE	TU	0.51	0.01
2-52-0-C	MAIN CONTROL STATION	C	0.61	0.02
1-40-1-T	UPTAKE	TU	0.48	0.02
2-24-4-Q	A/C MCHRY SPACE	QA	0.49	0.02
1-52-1-L	CREWS MESSROOM	LL	1.10	0.05
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.40	0.00
1-42-1-Q	GALLEY	QG	1.13	0.05
01-6-0-Q	EMER SWBD & GEN RM	QE	0.80	0.04
2-29-1-Q	SEWAGE MCHRY RM	QA	0.21	0.00
03-15-0-C	PILOT HOUSE	C	1.05	0.04
2-94-0-Q	STEERING GEAR RM	QA	0.07	0.01
3-52-01-E	PROPULSION MTR RM	EE	0.29	0.01
01-54-1-C	COMMUNICATION CTR	C	0.98	0.03
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.22	0.00
2-86-1-L	TUNNEL	LP	0.04	0.00
01-69-1-Q	HYD. POWER RM.	QA	0.07	0.01
01-G-0-A	BOSUN STORES	AS	0.08	0.00
01-2-1-A	STRM NO 1	AS	0.16	0.00
3-72-1-L	TUNNEL	LP	0.05	0.01
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.05	0.00
2-24-1-Q	LAUNDRY RM	QL	0.01	0.00

Notes: Results shown for every compartment with MAL = 1,2 or 3 and RLF > 0.00

Table C.3.4. Flammable Liquid Line Rupture Scenario Compared to Baseline

		Run No.	3-28 Baseline	3-58 FLLR
		Scenario	1	1
		Configuration	XRAY	XRAY
		Location	In Port	In Port
		Fire Prot Level	I,A,M	I,A,M
Plan ID	Compartment Name	CUI	RLF	RLF
1-34-2-Q	FAN ROOM	QF	0.22	0.28
3-34-0-E	MAIN GENERATOR RM	EM	0.22	0.28
1-44-2-Q	SCULLERY	QG	0.19	0.23
02-42-1-Q	FAN RM	QF	0.18	0.22
1-40-4-T	UPTAKE	TU	0.17	0.20
2-52-0-C	MAIN CONTROL STATION	C	0.14	0.18
1-40-1-T	UPTAKE	TU	0.13	0.17
2-24-4-Q	A/C MCHRY SPACE	QA	0.13	0.16
1-52-1-L	CREWS MESSROOM	LL	0.13	0.16
2-6-0-E	BOW THRUSTER ELEC MTR RM	EM	0.12	0.12
1-42-1-Q	GALLEY	QG	0.10	0.13
01-6-0-Q	EMER SWBD & GEN RM	QE	0.09	0.09
2-29-1-Q	SEWAGE MCHRY RM	QA	0.08	0.10
03-15-0-C	PILOT HOUSE	C	0.05	0.08
2-94-0-Q	STEERING GEAR RM	QA	0.04	0.04
3-52-01-E	PROPULSION MTR RM	EE	0.03	0.03
01-54-1-C	COMMUNICATION CTR	C	0.03	0.03
1A-34-2-Q	MAIN DECK UTILITY SPACE NO.4	QF	0.02	0.02
2-86-1-L	TUNNEL	LP	0.02	0.02
01-69-1-Q	HYD. POWER RM.	QA	0.02	0.02
01-G-0-A	BOSUN STORES	AS	0.02	0.02
01-2-1-A	STRM NO 1	AS	0.02	0.02
3-72-1-L	TUNNEL	LP	0.02	0.02
01-68-0-Q	ELECTRONICS & ELECTRICAL SHOP	QS	0.01	0.01

Notes: Results shown for every compartment with MAL = 1,2 or 3 and RLF > 0.00

Appendix D

FIRE PROTECTION DOCTRINE

The U.S. Coast Guard Cutter VINDICATOR (WMEC 3) Fire Protection Doctrine is organized into three parts: Part A contains the principles of fire science which are relevant to shipboard fire protection. Part B contains official policies and guidance promulgated by the Commandant, U.S. Coast Guard that pertain to firefighting on "large" cutters. For the purposes of this fire protection doctrine, "small" cutters are defined to be all cutters 65' and greater in length and less than 180' in length. The 225' VINDICATOR considered in this report is thus a "large" cutter in the Coast Guard fleet. Part C contains firefighting procedures and tactics for combating all classes of fires in all compartments in the VINDICATOR cutter class. Specific procedures are provided for 22 individual compartments as well as in-port fires. Part C also contains information pertinent to firefighting in the VINDICATOR such as:

- Compartmentation - access routes for firefighting and egress routes for personnel escape. In addition, particularly hazardous fuel loads are noted.
- Location and operating procedures for remote diesel engine shutdowns are provided.
- Location and type of installed fire detection equipment is listed.
- Specific information concerning installed and portable firefighting equipment is provided.

The following is an index for this appendix: Page

Fire Protection Doctrine - Part A

Principles of Fire Science

Table of Contents

Fire Protection Doctrine - Part A

Principles of Fire Science

I. Purpose

The purpose of this fire protection doctrine is to provide useful information pertinent to fire science (Part A), guidance promulgated by Commandant for firefighting on Coast Guard Cutters (Part B), and tactical firefighting procedures for each class of fire likely to be encountered, inport and underway (Part C). Part A of this doctrine applies to all Coast Guard Cutter Classes. Part B applies specifically to either "small" or "large" Coast Guard Cutter Classes. Small Cutters are defined, for the purposes of firefighting doctrine applicability, to be all cutter classes ranging in size from 65' WYTL Harbor Tugboats to 175' WLM (R) Coastal Buoy Tenders inclusive. Large Cutters are defined, for the purposes of firefighting doctrine applicability, to be all cutter classes ranging in size from 180' WLB Ocean-going Buoy Tenders to 399' WAGB Polar Icebreakers inclusive. Part C is Coast Guard Cutter Class specific and should be individually tailored to suit each ship in the class to account for minor differences. A complete fire protection doctrine for a cutter is therefore composed of three parts.

II. Shipboard Fire Protection

A. Philosophy

The guiding design philosophy of shipboard fire protection embraces a series of steps beginning with prevention and continuing in sequence through detection, confinement, control, extinguishment and finally post-extinguishment. It would be ideal if fires could be prevented from occurring in the first place, therefore considerable effort is made to prevent fires. If an unwanted fire does occur, it is desirable to detect the fire as early as possible and before the fire has a chance to grow. Detection can be accomplished with installed smoke, heat and flame detectors or the crew can detect the presence of smoke or fire. Once a fire is detected, the approach is to contain or isolate the fire to the "room of origin". If this is successful, the damage will be minimized. In some cases the fire will spread to involve other compartments through poorly designed (or maintained) bulkheads or open access fittings. In either event, the next step is to extinguish the fire. Extinguishment can be accomplished manually or with an automated, fixed fire protection system. The post-extinguishment step includes restoration of ship's systems to enable continuation of the ship's mission.

B. Fundamental Concepts of Fire

In a ship, fuels are present in solid, liquid and gaseous forms. Solid fuels include paper products, clothing, furniture, plastics and other common "ash-producing" substances. They are capable of smoldering for hours before bursting into visible flames. Plastic fuels (polyethylene, nylon, vinyls, etc.) usually produce higher burning rates and a higher heat content per unit weight than cellulosic fuels. In addition, plastics usually burn with extremely dense smoke and produce toxic gases such as carbon monoxide, hydrogen chloride and phosgene gas. Flammable liquids such as lube oil, hydraulic oil, diesel fuel,

JP-5, paints and solvents are usually found in engineering spaces and are often contained under pressure. Pound for pound, flammable liquids produce 2.5 times more heat than wood, and they release this heat 3 to 10 times faster. When flammable liquids spill, or worse, spray under pressure on a hot surface, the resulting fire burns with tremendous intensity. Many of the major conflagrations on ships are a result of flammable liquid spray fires in the engine room. There are both natural and manufactured flammable gases. Those commonly found on board ship include acetylene, propane, and butane. Gases, like flammable liquids, usually produce visible flames and will not smolder.

1. Fire Tetrahedron

Combustion or rapid oxidation describes a process in which a fuel pyrolizes or turns into a vapor and mixes with oxygen at a high rate of speed; heat and light, visibly seen as flames, are by-products of this process. The heat generated by combustion travels in all directions including back toward the fire which in turn pyrolizes more fuel and thus a chain reaction is established. Fuel, heat and oxygen are thus required for the existence of fire as well as the chain reaction process described. The fire tetrahedron, shown in Figure A-1, is a graphic representation of the combustion process. If any of the four faces of the tetrahedron are removed, the fire will be extinguished.

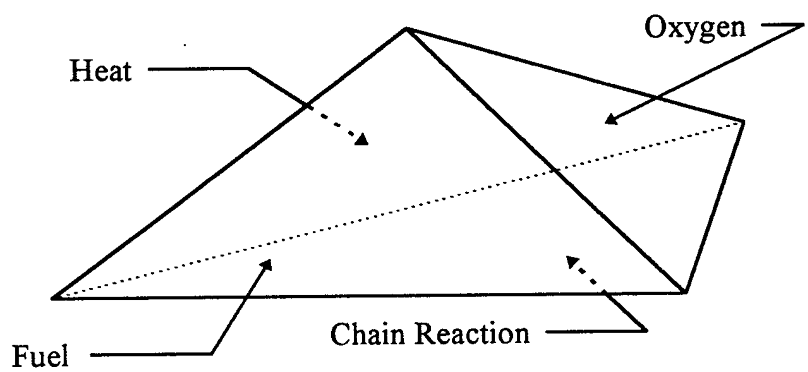

Figure A.1 The Fire Tetrahedron

2. Classification of Fire

Fires are grouped into four classes according to the type of fuel as shown in Table A-1. Sometimes due to the presence of multiple fuel types a combination of classes of fire will occur. Electrical fires, for example, almost always involve a solid or liquid fuel as well.

TABLE A.1 CLASSES OF FIRE

Class	Fuel
A	Solid Fuels
B	Flammable Liquids or Gases
C	Electrical
D	Combustible Metals

3. Extinguishing Agents

An extinguishing agent operates by removing one or more faces of the fire tetrahedron using one of the following four methods:

- Cooling. This is a direct attack on the heat face of the tetrahedron. The goal is to reduce the temperature of the fuel below its ignition temperature.
- Smothering. This is an attack on the edge of the tetrahedron where the fuel and oxygen meet. The action is to separate the fuel from the oxygen.
- Oxygen Dilution. This is an attack on the oxygen face where the goal is to reduce the oxygen content below that necessary to sustain combustion.
- Chain Reaction Breaking. The goal here is to interrupt the chain reaction long enough for the fuel to cool below its ignition point.

There are six fire extinguishing agents normally encountered in shipboard firefighting. These agents are in the form of liquids (3), gases (2) or solids (1). The choice of agent is based on the class of fire and the agents available to fight the fire. The following sections discuss the agents available, their advantages and disadvantages.

a) Liquid

By far the most common extinguishing agent is water. Salt or fresh water is very effective on class A fires while aqueous film-forming foam (AFFF) is effective against class B fires and deep seated class A fires. The advantage of using water is its inexhaustible supply; the disadvantage is that water conducts electricity and adversely affects the stability of the ship if too much accumulates. AFFF has persistence and will remain effective as a blanketing agent for several hours, but has to be washed from machinery after the fire is out. Aqueous potassium carbonate is primarily used to combat galley deep fat fryer fires and their exhaust systems.

b) Gas

Halon is a manufactured chlorofluorocarbon (CFC) and is extremely effective against all classes of fire. The advantages of Halon are that it is clean, non lethal (in concentrations sufficient to extinguish fire), non-conducting, and extremely fast in extinguishing fires. Like freon and other CFCs, it apparently damages the ozone in the atmosphere and is being phased out of production. CO_2 is an effective agent against class C fires and is non-conductive and non-corrosive. CO_2 is clean, effective, and environmentally acceptable, but it is lethal in quantities sufficient to extinguish fire.

c) Solid

Potassium bicarbonate powder (PKP)is the only dry chemical authorized for use in portable extinguishers on Coast Guard Cutters and Boats and is effective against all classes of fires. This agent is non-lethal and non-conducting but on the other hand it is corrosive to electronic equipment and difficult to clean up.

III. Prevention

There are four basic principles of fire prevention which should be observed routinely to reduce shipboard fire hazards.

A. Frequent Inspections

It is the responsibility of every crewmember to prevent fires. Accordingly, the entire crew should be constantly alert to eliminate fire hazards. Fire hazards should be brought to the attention of the Commanding Officer/Officer-in-Charge who can take appropriate action.

B. Proper Stowage of Combustibles

Paint, flammable liquids, ordnance and munitions should only be stowed on board in spaces specifically designed for the purpose or on weather decks. These spaces will be protected with explosion proof lights, noncombustible shelving, fire detectors, and an automated total flooding fire protection system. Paint lockers, magazines and other spaces specifically designed for extremely flammable or explosive products are not generally found on small cutters.

C. Training and Education

Frequent fire drills and team training should be conducted so that in an emergency the crew will respond correctly and automatically. Education in the principles of fire science will permit the proper selection of a firefighting agent and equipment depending on the class of fire encountered. Training will permit the proper use of the firefighting equipment installed or available on board.

D. Enforcement of Fire Prevention Policies and Practices

The following policies and practices will minimize fire hazards and reduce the chances of uncontrolled growth if a fire should occur.

- Maintain flange shields on flammable liquid piping.
- Maintain proper covers on flammable liquid strainers.
- Keep sounding tube caps in place and isolation valves closed.
- Take immediate action to stop and repair all oil leaks.
- Keep ventilation ducts clean and free from oily residue.
- Keep bilges free of trash and oil.
- Do not allow unauthorized flammable materials on board.
- Do not stow combustible materials in voids or uptakes.
- Do not stow combustibles in direct contact with bulkheads and decks - allow for at least one foot stand-off distance.

- Perform preventive maintenance on firefighting equipment in accordance with authorized procedures. Ensure all interlocks work properly.
- Operate firefighting equipment in accordance with procedures established in this doctrine and other authorized documents.
- Maintain damage control closures and fittings in accordance with the authorized material condition of readiness.
- Comply with authorized tag-out procedures for electrical and mechanical equipment.

IV. Detection

There are two types of fire detectors: the installed smoke, heat and flame detectors found in berthing compartments, magazines, engine rooms, and other spaces, and the crew, who should be constantly vigilant to the presence of smoke or flames. A crew member has two basic duties to perform in the event that fire or smoke is detected: sounding the alarm, and making an effort to extinguish or at least contain the fire. The person discovering the fire should sound the alarm first then attempt to apply first aid. The crew member should attempt to extinguish the fire with the nearest available extinguisher that dispenses the appropriate firefighting agent if this first aid can be accomplished safely. If first aid is not immediately effective, the crewmember should evacuate the space and contain the fire by closing the door to the compartment.

A. Equipment

Fire detectors sense, and initiate a signal in response to, heat, smoke, flame or some other indication of fire. The types of detectors that are in common use are discussed in the next section.

1. Smoke Detectors (products of combustion)

The smoke detector continuously samples the air for the products of combustion, specifically smoke particles. There are various types of smoke detector, the most common include the ionization and photoelectric types. Ionization detectors operate on the principle that smoke interferes with the flow of ionized particles created in the detector. The photoelectric type measures the amount of obscurity in a light beam created by the detector.

2. Heat-actuated Fire Detectors (fixed temperature, rate of rise)

The primary classes of heat-actuated devices are fixed-temperature detectors and rate-of-rise detectors. A fixed-temperature detector initiates an alarm when the temperature of the device reaches a pre-set value. Note the device itself has to reach this temperature - not just the air around it. This thermal lag is proportional to the rate of rise of the air temperature. Rate of rise detectors sense the rate at which the temperature is rising and sounds an alarm when this rate exceeds the allowable value. Rate of rise detectors will reset themselves, whereas fixed temperature detectors will not.

3. Flame Detectors (optical)

Flame detectors are designed to recognize certain characteristics of flames such as light intensity, flicker (pulsation) frequency and radiant energy levels. Flame detectors are not commonly found on board ship due to false alarms. For example arcs from welding, or light reflecting off the water's surface sometimes cause flickering which are misinterpreted by the detector. Electric light bulbs also tend to flicker if the ship is vibrating.

B. Operation

Detectors are designed to operate continuously with minimal maintenance and are inherently reliable. They are usually battery powered or wired for 110 volt electrical power. In general, on Coast Guard Cutters, detectors sound the alarm only, they do not automatically discharge a firefighting agent.

V. Confinement

The initial actions by the person who discovers a fire can make the difference between a controllable fire and one which threatens life of the ship. Any crew member discovering a fire or an indication of fire must immediately sound the alarm. The report of a fire must reach the Officer of the Deck by whatever method available, such as messenger, telephone, announcing system, intercom, installed fire alarm system, or human voice. If the fire is small and appears capable of being controlled, then an initial attack can be attempted by personnel with little or no protection. The use of more than one portable extinguisher simultaneously is more effective than using them one at a time. If the fire is large, or if the compartment of origin is unknown, or if the fire is fed by a pressurized fuel source, then the initial actions should be to contain and isolate the fire. This can be accomplished by taking advantage of the design of the vessel (passive measures) and by isolating the fire from sources of fuel and oxygen (active measures). The following sections discuss these passive and active measures.

A. Passive Measures

Passive measures include features that are designed into the cutter that serve to inhibit fire growth.

1. Compartmentation

A ship is subdivided into compartments for several purposes, not the least of which is to provide barriers to fire, smoke, and flooding.

a) Barriers.

Barriers include the bulkheads, decks and overheads that define a compartment's boundaries. Watertight bulkheads are designed to resist both fire and flooding. Non-watertight joiner bulkheads serve a useful purpose to slow the spread of fire and smoke but are generally ineffective to prevent progressive flooding. Doors, windows and

portholes are often open to provide ventilation and access for the crew; these must be immediately closed in the event of fire or flooding to maximize the barriers' effectiveness.

b) Fuel Loading.

A fire cannot burn without fuel. Therefore if the fire can be isolated in a compartment that has minimal fuel loading, the fire will go out on its own. The distribution of the fuel loading is an important factor in fire growth. For example, if the fuel is stacked vertically (opposed to horizontally) the fire will grow more quickly for the same amount of fuel. Fire will also spread more quickly in bookcases with the glass doors open than with the doors closed. Simply closing the doors on bookcases before leaving the ship's office is a good example of how one can take advantage of the ship's passive fire protection features to prevent fire growth.

The type of fuel is a very important factor. There are two basic types of solid fuel: cellulosic and plastic. Cellulosic fuels are basically wood-based products such as paper, wood, and cotton. Plastics include a lot of the modern manufactured products such as polystyrene (liners in refrigerators), foams and vinyls (padding and upholstery used in cushions), and polyesters (clothing). Plastics, in general, have heat release rates that are five to ten times greater than cellulosics. Sleeping bags brought on board by the crew for example, may be five to ten times more hazardous than wool blankets.

2. Construction Materials

Non-flammable construction materials are normally specified in new construction. The crew is cautioned that decorative sheathing or paneling installed during habitability improvement projects should not include flammable materials. Likewise, if the cushions on the mess deck benches are reupholstered, the selection of materials should be in accordance with guidance on acceptable products and materials. This guidance should be obtained from the Naval Engineering Manual, COMDTINST M9000.6 (Series), or from the MLC (v) division.

B. Active Measures

Active measures include actions that the ship's crew can take to isolate and contain a fire.

1. Setting Material Condition ZEBRA

One of the most basic procedures in shipboard firefighting is setting material condition ZEBRA which is intended to close all doors and windows in all the barriers to a fire.

2. Securing Ventilation

Securing supply and exhaust ventilation fans and installing available covers over the inlet or exhaust will reduce the available oxygen to a fire. Positive ventilation should be provided where possible to spaces outside the smoke boundaries. In addition, desmoking efforts during firefighting will help to improve the visibility for the firefighters.

3. Securing Fuel

In a class B fire it is absolutely essential to secure the fuel to operating engines. Attempts to extinguish the fire will be frustrated until the source of the fuel is secured. Remote fuel shutoffs are provided outside the machinery space to safely secure the fuel supply. It should be noted that after securing the fuel supply the engine will continue to run for a short time to consume the in-line fuel.

4. Securing Electrical Power.

Securing the electrical power will extinguish a class C fire. Additional extinguishment efforts may be required if a class A or B fire is also involved. The fire pumps on most cutters are electrically operated. Therefore an alternate source of firefighting water pressure may be required in the event electrical power is secured.

VI. Extinguishment

A. Firefighting Equipment

The firefighting systems described below are installed on Coast Guard Cutters. Each has capabilities and limitations which must be understood by firefighting personnel to ensure quick and proper selection of equipment. Each cutter has a subset of these systems and it is important to know which systems/equipment are available for use. This specific information is located in Part C of the fire protection doctrine for each cutter. The following information is a basic introduction to firefighting equipment typically found on board Coast Guard Cutters. All personnel should read the following publications for more detailed information:

- Naval Ship's Technical Manuals (Chapters 555, 077 and 079 vol 1-3)
- Naval Engineering Manual (COMDTINST M9000.6 (Series))
- Surface Ship Survivability Manual (NWP 62-1 (Series))

1. Firemain System

The firemain system consists of installed piping to distribute water to fire stations located throughout the ship. This piping may be exposed to freezing temperatures, the weight of the water in the system would adversely affect stability, and operating the fire pumps without overboard reliefs would burn up the pumps, therefore this system is normally dry and has to be charged with water from an installed electric pump or a portable pump. The system is normally used to energize fire hoses for fighting class A fires or for the production of AFFF water mixture for class B fires. When a hose line attack is needed to attack a flammable liquid fire, water fog may be used (fog position on the Coast Guard vari-nozzle) as the primary extinguishing agent. However, the time required to fight the fire will be longer, more firefighters will be required, increased fire damage can be expected, and risk of reflash is greater than if AFFF were used.

2. Firehose and Nozzle

The standard hose used on Coast Guard Cutters is an orange colored, chlorosulfonated, polyethylene (hypolon), impregnated, double jacketed , synthetic rubber hose in two sizes - 1 1/2" and 2 1/2", and one length - 50 ft. The hose is configured with a brass male coupling on one end and a brass female coupling on the other. The male end always goes to the scene of the fire. The exposed brass threads on the male coupling are easily damaged which may prevent installation of a nozzle. Two lengths may be connected and the couplings should be hand tightened. The spanner wrench at the fire station should not be used for this purpose, this wrench should be used to loosen the connection between the fire station and the firehose. Fire stations are located on the cutter such that two hoses can be brought to bear in any compartment. This may require the installation of two lengths of fire hose on some fire stations.

The Coast Guard Vari-nozzle is manufactured by Akron Brass (style 3019) and Elkhart Brass (SFL-GN-95). It is designed for a 95 gpm flow rate and is used to produce AFFF with a style 2901 inline proportioner.

3. Portable Pumps

Portable pumps serve a dual purpose. First, they may be used to provide a source of firefighting water on the cutter itself or for another vessel in distress. The portable pump can serve as a backup to the installed electric pump or as the primary source in case the electric pump is unavailable. This is often the case in an engine room fire where most electric pumps are installed. Secondly, they can be used as a means of dewatering. Since a portable pump is driven by an internal combustion engine, it must be operated on the weather deck. The designation of portable pumps includes the rate in gallons per minute the pump is deigned to produce.

a) P-250 Mod 1 Pump

This pump is a portable, gasoline engine driven pump. It is designed for use in firefighting and dewatering operations. It will produce 250 gpm at 100 psi using two 1 1/2" hoses and one 2 1/2" eductor. For dewatering contaminated spaces, the P-250 pump can be used in conjunction with a peri-jet eductor; the pump can draw a suction directly on uncontaminated spaces if the suction hose will reach the space from the weather deck. The peri-jet eductor is a venturi that is designed to discharge approximately two times the amount of water pumped through it. If the eductor discharge becomes blocked, the eductor will very quickly flood the compartment it is supposed to be dewatering. A careful and frequent check must be conducted to ensure the eductor is working satisfactorily.

b) CG P-1B Pump

These pumps are portable, lightweight, self contained pumps used for dewatering only. The CG P-1B will dewater at the rate of 120 gpm with a 10' suction lift and 20' discharge head.

c) CG P-5 Pump

The CG P-5 pump can be used for dewatering and limited firefighting and AFFF application at the rate of 200 gpm with a 10' suction lift.

4. Automated Fixed Flooding Systems

A class B fire in the engine room is capable of extremely rapid growth to major conflagration proportions in a matter of minutes if not seconds. Since it typically requires ten minutes or more for a ship to set Zebra, man repair parties, rig firehoses, and dress out a firefighting party in firefighting ensembles, an automated fixed flooding system may be installed to combat this type of problem. Magazines are usually protected by an automated fixed flooding system as well.

a) CO_2 System

Fixed CO_2 systems are installed in paint lockers, flammable liquid storerooms, and engine rooms. It is normally designed to totally flood the space and includes automatic shutdown of installed ventilation systems. The system normally includes a manually activated remote pull box, audible and visual alarms. If the space protected is normally occupied and there is a vertical exit to the weather deck, a 60 second discharge time delay is mandatory to permit evacuation of personnel since CO_2 is lethal in the concentrations required to extinguish fires. CO_2 is heavier than air and will persist in the protected space even if openings in the overhead are present.

b) Halon 1301 System

Halon 1301 is installed in the engine room since halon is extremely effective against class B fires and accidental discharge is non-lethal in the concentrations required to extinguish fires. However, if halon is ingested by internal combustion engines, or if halon is exposed to the fire itself for more than ten seconds, the byproducts from the combustion of halon are toxic to humans. Therefore the design of Halon 1301 total flooding systems include discharge times of less than ten seconds, and include automatic shutdown of internal combustion engines and ventilation equipment in the protected spaces. A 60 second time delay, visual and audible alarms, similar to CO_2 systems, are included in the design of Halon 1301 flooding systems to permit evacuation of the space before discharging Halon. When it is released, Halon 1301 vaporizes to a colorless, odorless gas with a density approximately five times that of air. Halon concentrations between 5% and 7% are required to extinguish fires. Sufficient volume is provided to maintain this concentration for at least 15 minutes, therefore it is important to seal the protected space to prevent escape of the agent. In addition, two "shots" are usually provided that are capable of completely flooding the protected space twice. The second shot is designed to be used if the first shot is ineffective or in the event of a reflash.

c) Aqueous Film Forming Foam (AFFF)

AFFF is composed of synthetically produced materials similar to liquid detergents. For shipboard use, six parts of AFFF concentrate are mixed with 94 parts water. The bilge area in engine rooms may be protected by installed nozzles which distribute pre-

mixed AFFF. AFFF, when proportioned with water provides three firefighting advantages: First, due to its low viscosity it quickly spreads over the surface of burning fuel, the aqueous film thus formed excludes air. Second, the foam layer prevents the escape of fuel vapors. Third, the water content of the foam provides a cooling effect.

d) Aqueous Potassium Carbonate

Aqueous potassium carbonate (APC) is used to extinguish burning cooking oil and grease in deep fat fryers and galley ventilation exhaust ducts. APC solution consists of 42.2% potassium carbonate and 57.8% water. When APC comes in contact with the burning surface, it generates a soap-like froth that excludes air from the surface of the grease or oil and thus extinguishes the fire.

5. Portable Fire Extinguishers

"First-aid" in the context of firefighting is the immediate attempt to extinguish a discovered fire. Portable extinguishers are installed throughout the ship to facilitate this effort. The location of the various types of extinguishers take into account the most likely class of fire that will occur considering the fuel loading. The following information is provided to assist in the selection of an appropriate extinguisher.

a) Carbon Dioxide (CO_2)

CO_2 is primarily used to extinguish small class C fires. They have limited effectiveness on small class A and class B fires of low heat intensity and an involved surface area of four square feet or less. A successful attack requires a close approach due to an effective range of four to six feet. Caution is required when using CO_2, especially when more than one extinguisher is used, as CO_2 displaces oxygen.

b) Purple-K-Powder (PKP)

Purple K gets its name from the purple color of the potassium (chemical symbol "K") bicarbonate chemical stored in the extinguisher. The agent is expelled under pressure from a CO_2 or nitrogen cartridge installed in the extinguisher. PKP is very effective on small, isolated class B pool fires (fires less than 10 square feet). PKP is not effective against spray fires. The maximum range for a portable PKP extinguisher is 20 feet. PKP is intended for use by the unprotected operator who is in the best position to take initial action to extinguish a fire at its onset. Successful use of PKP is time critical.

B. Personnel Protection

1. Emergency Escape Breathing Device (EEBD)

The EEBD is designed to provide breathing air and eye protection during emergency escape from areas containing toxic gases and smoke. Each EEBD has a flame retardant hood and plastic face shield. It generates 15 minutes of breathable air by means of a low pressure chemical oxygen generator. The EEBD is designed for emergency escape only and shall not be used as a piece of offensive firefighting equipment. Naval

Ships' Technical Manual, chapters 077 and 079 vol. 2 provide operation and maintenance instructions.

2. Oxygen Breathing Apparatus (OBA)

The only breathing apparatus authorized for use on board cutters and boats is the Navy Type A-4 OBA. The green, self-starting, single candle type canister is the only authorized canister for use with the Type A-4 OBA. Red canisters are to be used for training only and shall not be stored in repair lockers. Immediately after a wearer activates a canister, the timer shall be turned to 60 minutes and then turned back to 45 minutes.

If a person wearing an OBA is working alone in a smoke-filled or oxygen-deficient compartment, an insulated tending line shall be used with a tender. The tender shall wear 7500-volt rubber gloves, inside leather gloves, and rubber boots. The tender shall ground the end of the line to bare metal ships structure and be observant of signals from the OBA wearer. It is not recommended for an OBA wearer to enter a machinery space alone with a tending line due to the number of interferences. Two OBA wearers should enter the area together. If a second OBA wearer is not available, then a tending line must be used when a machinery space is entered.

3. Clothing

A fire can reach temperatures exceeding 2000 degrees Fahrenheit and produce dangerous concentrations of smoke and toxic gases. Cutters less than 133' and the 160' WLIC class have an allowance of two firefighters ensembles (FFE); larger cutters have an allowance of four FFEs. The optimum time to don a FFE is approximately 2 minutes, with another 1 to 2 minutes to don and activate an OBA. Under ideal conditions, it takes 2.5 to 5 minutes to don full personnel protection clothing. The scene leader should consider the time it takes to dress out in FFEs allows the fire to grow. In certain situations, rapid response with less protected personnel may result in quick knockdown of a fire. The scene leader makes the decision to request the FFE taking into account the tenability of the area, stage of the fire, and success of the initial attack.

The FFE consists of firefighter's coveralls, firefighter's antiflash hood, damage control/firefighter's helmet, firefighter's gloves, and fireman's boots. Repair party personnel not required to wear the FFE shall wear fire retardant long sleeved uniforms/coveralls, hard shell battle helmet, antiflash hood and gloves. The FFE helmet shall not be altered in any way.

The aluminized firefighting suits are only used aboard flight deck equipped cutters. Description and maintenance instructions are provided in Naval Ships' Technical Manual, Chapter 077, and the Shipboard Helicopter Operational Procedures Manual, COMDTINST M3710.2.

4. Naval Firefighting Thermal Imager (NFTI)

The NFTI is a device that permits the user to see through dense smoke and light steam. It can be used to:

- Investigate reported fires
- locate the seat of a fire
- locate and facilitate rescue of injured personnel
- Set and maintain fire boundaries
- locate ignition sources during fire overhaul

The scene leader shall decide when to deploy the NFTI. The NFTI cannot "see" through glass, therefore it is not useful to determine the effectiveness of a Halon 1301 release by "looking" through a viewing port.

Naval Ships' Technical Manual, chapter 555, provides detailed operating instructions and information concerning the tactics for using the NFTI.

5. Firefinder

The firefinder is a small handheld version of the larger NFTI but the principles of operation are the same. Firefinders are sometimes found on small cutters which are not authorized an allowance for a NFTI.

VII. Post-Extinguishment Activities

Overhaul of a fire is an examination and cleanup operation. In addition, ship systems are restored to permit a ship to continue its mission if possible.

A. Desmoking

Small cutters are not equipped with portable desmoking equipment, therefore these cutters should use installed ventilation systems, natural means, or borrowed equipment for desmoking operations. The following sections describe desmoking equipment commonly found on board larger cutters.

1. Red-Devil Blower

The rated capacity of the red devil blower is 500 cfm with 200 ft of 8 inch hose attached. This blower is driven by an explosion proof motor. This blower should not be used to handle air containing explosive vapors. The ram fan discussed in the next section is appropriate for this type of problem.

2. Ram-Fan

The ram fan uses the water pressure for firefighting to drive a turbine for exhausting air. Because it is water driven it can be used below decks in confined areas and is suitable for exhausting explosive vapors.

B. Compartment Testing

The post-fire atmosphere in a compartment shall be tested in sequence for oxygen, combustible gases and toxic gases. Ventilating and retesting is required if initial test results are unsatisfactory.

C. Dewatering

Free water can dramatically impair the stability of a vessel. Every effort should be made to limit the amount of water used; for example preference should be given to the use of water fog over solid streams. Only as much water as is absolutely necessary should be used. Dewatering operations should commence as soon as possible if water is used as an extinguishing agent.

D. Restoration of Ship's Systems

Electrical power should be restored as soon as possible so that installed ventilation equipment can be operated for desmoking and so that the electric fire pumps are potentially ready for use. Preference in restoring ship systems should be given to electrical power first, then main propulsion, then support systems for crew comfort such as air conditioning and other "hotel" services.

E. Examination and Investigation

The objectives of post-fire examination and investigation are to find and extinguish hidden fire and hot embers. This is an important aspect of firefighting and should be conducted as seriously as extinguishment of the fire itself. Overhaul personnel should investigate ventilation ducts and determine the extent the fire has traveled. Spaces behind paneling and false overheads should be carefully inspected. Wiring and piping penetrations in bulkheads and decks should be carefully inspected because fire can penetrate through extremely small spaces. Signs of structural weakness (especially in aluminum structures) should be reported and strengthened if necessary by shoring and other means. Finally a thorough investigation of the cause of the fire should be conducted and lessons learned documented so that similar fires can be prevented.

Fire Protection Doctrine - Part B

Policies for Firefighting on Large Cutters

Table of Contents

Fire Protection Doctrine - Part B

Policies for Firefighting on Large Cutters

I. Introduction

The approach to firefighting is quite different depending on the classification of the cutter as large or small. "Large" Coast Guard Cutters spend extended periods of time underway, routinely operate off-shore where assistance in the first hour of a fire may not be available, and generally carry hazardous substances such as munitions, paint and flammable substances to facilitate self-sustaining operations. Moreover, the crew size is usually adequate to man multiple repair parties and the cutters' missions often include military readiness which increases the risk of fire damage from enemy action. All of these considerations distinguish these cutters from "small" cutters which generally make day trips and put into port at night. Their area of operations is close to shore where assistance is readily available and/or abandoning ship is quite feasible. Small cutters do not generally carry paint and other extremely flammable substances on board, this type of material is usually stored ashore in the cutters homeport. Small cutter crew size is minimal and often does not permit manning multiple repair parties. Finally, these cutters do not generally have a military readiness mission, therefore the fire threat from enemy action is virtually non-existent.

In the Coast Guard all vessels with a permanently assigned crew are considered cutters. The smallest cutter is a 65' WYTL Harbor Tugboat and the largest is a 399' WAGB Polar Icebreaker. Small Cutters are defined, <u>for the purposes of fire protection doctrine</u>, to be all cutter classes ranging in size from 65' WYTL Harbor Tugboats to 175' WLM (R) Coastal Buoy Tenders inclusive. Large Cutters are defined, <u>for the purposes of fire protection doctrine</u>, to be all cutter classes ranging in size from 180' WLB Ocean-going Buoy Tenders to 399' WAGB Polar Icebreakers inclusive. Therefore there are two versions of Part B, one for small cutters and one for large cutters. The purpose of Part B of the fire protection doctrine is to define the philosophical approach and policy applicable to firefighting on cutters. This approach and philosophy is guidance provided by the Commandant and is mandatory for Coast Guard Cutters. The Commandant will issue revisions to this guidance periodically. Part A of the fire protection doctrine provides information pertinent to fire science and applies to all Coast Guard Cutters. Part C of the fire protection doctrine provides firefighting procedures and tactics specific to a class of cutter. The Commanding Officer is required to tailor Part C of the doctrine (within the guidelines provided in Parts A and B) to suit the particular needs of the individual cutter.

II. Firefighting Philosophy and Approach

In very general terms, the firefighting approach on a large cutter employs the following sequence:

- The person discovering the presence of smoke or visible flames shall notify the Bridge with the location and class of fire and attempt to apply first aid on fires that are small enough to safely extinguish with a portable extinguisher.

- The Bridge shall sound the General Quarters alarm and announce the location and class of fire over the 1MC. The Bridge shall also announce that this is not a drill.
- All personnel shall immediately proceed to their assigned station as specified in the Watch Quarter and Station Bill, setting condition Zebra in route to their station.
- As directed by the scene leader, repair parties shall break out appropriate firefighting equipment, dress out in firefighting ensembles, and proceed to the scene of the fire.
- Extinguish the fire by activating installed fixed fire extinguishing systems and/or manually combat the fire as directed by the scene leader
- Overhaul the fire, test for explosive gases, desmoke, dewater, and restore ship's systems.

On fires declared "out of control" in the engineering spaces, the general approach is to evacuate the space, secure the pressurized source of fuel, activate the installed total flooding system and prepare to reenter the space with fire hoses rigged to apply AFFF. On larger fires in other spaces the crew should combat the fire as directed by the scene leader with the installed firemain system/water, AFFF, or CO_2 depending on the class of fire. Initial efforts to combat a discovered fire (first aid) with a portable extinguisher should be attempted if the size of the fire is small enough to attempt extinguishment safely. The following sections provides guidance on the philosophy and approach that should be employed on large cutters in the various stages of firefighting from prevention through post-extinguishment activities.

A. Prevention

The Commanding Officer, Department Heads, and the Damage Control Assistant (DCA) shall make frequent inspections of the cutter for the presence of fire hazards, unauthorized stowage of flammable materials, and proper operation/installation of fire and smoke detectors. Paint and other extremely hazardous materials such as pryotechnics and ammunition shall be stowed only in authorized compartments such as the Paint Locker, Pyrotechnics Locker and Magazines. Paint Lockers are usually protected with an installed CO_2 or Halon 1301 flooding system. Ammunition and ordnance shall only be stowed in magazines protected with a water flooding system. Flammable liquids shall only be stowed on board in designated storage tanks; drums of lube oil, hydraulic oil etc. shall be stowed ashore or on weather decks only.

The inspections conducted by the Commanding Officer, Department Heads, and DCA shall also determine that the installed fire protection systems and detectors are installed properly and ready for instant use. Battery powered smoke detectors shall be tested frequently to ensure the batteries have not been removed or discharged. Discrepancies discovered during these inspections shall be given the highest priority.

B. Detection

The watchstanders shall make rounds at least hourly underway and once every four hours in port of every space that has significant fuel loading to detect the presence of fire

and smoke. This inspection may be conducted in parallel with rounds conducted by watchstanders for other purposes such as security or engineering checks.

Where fixed fire alarm systems are not provided, the installation of self-contained, battery operated, smoke detectors shall be required for the protection or personnel in sick bays and berthing areas in accordance with the guidelines contained in the Naval Engineering Manual (COMDTINST M9000.6 (Series) chapter 985).

If a fire is reported, the general quarters alarm shall be sounded and the location and class of fire shall be announced over the general announcing system (1MC). The Emergency Diesel (or Gas Turbine) Generator shall be started and placed in standby. The firemain shall be pressurized and a P-250 shall be rigged and started as a backup source of firefighting water. The crew shall muster at their general quarters station.

C. Containment

Historically, the majority of high dollar value fire losses have occurred as a result of class B fires in the main machinery space. Moreover, fires can easily spread from one compartment to the next through open doors and hatches. Therefore, all doors and hatches to main machinery spaces shall be normally closed in port and underway in accordance with the material condition of readiness in effect. In addition, the crew should be constantly vigilant to control the quantity, type, and distribution of fuel loads to maximize the benefits from passive fire protection features that serve to inhibit fire growth.

The Commanding Officer/OOD shall maneuver the cutter underway to minimize the relative wind which could "fan" the fire. An important exception to this rule is for engine room fires. All fires in the engine room include the possibility of a flammable liquid spray fire, therefore the main engines shall normally be secured for all fires reported in the engine room. The Commanding Officer may delay securing the main engines due to a navigation hazard. The ship service generators shall be secured and the emergency generator placed on the line in the event of a fire in the engine room. A P-250 portable pump shall be rigged and started to provide a backup source of firefighting water pressure.

For major fires, especially where extreme heat denies access to the fire compartment, boundary cooling of surrounding bulkheads and decks is essential to prevent horizontal and vertical fire spread. Use intermittent bursts of water from a partially open vari nozzle.

The fire shall be isolated by setting material condition ZEBRA, securing ventilation, and installing all available inlet and exhaust ventilation covers. Electrical power shall be secured in the compartment where the fire was reported; however lighting in affected spaces shall be secured at the scene leader's discretion.

D. Extinguishment

Standard damage control communications shall be used in firefighting operations. The priority of communications shall be in accordance with the following list. Note, not all cutters have all of these systems and some ships may have other means of

communication, but the order of precedence still applies. This list takes into account the fact that on most large cutters the human voice cannot be heard throughout the cutter.

- Handheld Radio
- Sound Powered Phone
- Ship's Internal Phone System
- Salt and Pepper Line
- Damage Control Messages - Runners

The use of damage control wire-free communications (DC WIFCOM) is authorized to supplement, not replace, standard interior communications hard wired circuits (i.e. sound powered phones) for repair party personnel. Where DC WIFCOM is available it may be used as the primary means of communications within the repair locker organization (scene leaders and investigators). DC WIFCOM users shall continue to train in message writing to maintain their skills.

In general there are two basic approaches to extinguish fires - passive and active. The passive approach includes completely isolating the fire and letting the fire extinguish itself. This is feasible if the compartmentation permits closing all accesses to the affected compartment, the ventilation and electrical power can be completely secured, and pressurized sources of fuel can be secured. The active approach includes discharging a firefighting agent on the fire. This can be accomplished with an indirect attack by activating an installed fixed total flooding system or direct attack by a manual application of the agent. In either event it is critical that the agent used is appropriate for the class of fire. The crew should be prepared to aggressively attack the fire if the passive approach is unsuccessful or not feasible. In port, the majority of the crew may be ashore, but the inport duty section should be adequate to combat a fire at least until additional help arrives. This help may come from other ships in port or from the city fire department. Accordingly, the DCA should ensure that a plan for mutual aid is in place with other cutters and the city fire department should be invited to visit the ship for familiarity. The following sections provide specific guidance for firefighting underway and in port.

1. Underway

The person discovering a fire underway should ensure that the Bridge is notified of the fire - if necessary, before attempting to extinguish the fire. The class of fire (class A, B or C) and its location shall be passed to the Bridge so that the crew can take appropriate action. The location shall include the compartment's noun name and identification ("Engine Room, Compartment 3-46-0-E" for example).

The next step involves application of "first aid" with a portable extinguisher on fires small enough to attempt extinguishment safely. On larger fires the person discovering the fire should close all doors, hatches, windows and other accesses to the compartment to isolate the fire. CO_2 and PKP portable extinguishers are strategically located throughout the cutter. Either agent is more or less effective against all classes of fire but Table B-1 specifies the preferred agent for each class of fire. Do not attempt to

extinguish a flammable liquid spray fire until the source of the pressurized fuel is secured. Do not discharge a CO_2 fire extinguisher in a small enclosed space without respiratory protection.

TABLE B-1 FIRST AID FIREFIGHTING AGENTS

CLASS	PREFERRED AGENT
A	PKP
B	PKP
C	CO_2

If a class B fire in the machinery spaces cannot be extinguished immediately with PKP, the fire shall be declared "out of control", the space shall be evacuated, pressurized fuel sources shall be secured and the installed total flooding system shall be activated. The on scene leader shall ascertain the effectiveness of the firefighting agent and recommend discharging a second "shot" of firefighting agent if available. The following actions can be used to make this determination:

- monitoring the fire through a viewing port in the door (Note NFTI cannot "see" through glass)
- monitoring temperatures in the space
- observing smoke discharging from vents
- observing paint blistering and discoloring on bulkheads

In either event, 15 minutes shall elapse before attempting re-entry to permit cooling of hot surfaces below the ignition point. Re-entry shall only be attempted by personnel properly dressed in a FFE and prepared to apply AFFF as the primary firefighting agent.

A flammable liquid spray fire shall be automatically considered a class B fire out of control. Past experience and fire testing have shown that a pressurized release of a flammable liquid can create a fire that is unapproachable. Life threatening conditions created by extreme heat, smoke and toxic gases can occur in as little as 60 seconds. Under such conditions the only prudent course of action is to evacuate the space, secure the fuel source and activate the installed total flooding system.

An oil leak in the engine room shall be repaired immediately, a major oil leak shall be automatically considered equivalent to a class B fire. That is, it shall be reported immediately to the bridge, engines shall be secured and preparations to fight a class B fire with AFFF shall be accomplished.

The decision to secure lighting in affected spaces shall be made by the on scene leader. Every effort shall be made to mechanically and electrically (other than lighting)

isolate the affected spaces. The decision to commence firefighting efforts may be made by the on scene leader before electrical isolation is complete.

Re-entry into a machinery space that has been evacuated because a fire was declared out of control is the most critical and hazardous part of the firefighting evolution. The decision to reenter the space should be made only if there is reasonable evidence that the fire is out. Re-entry personnel shall be dressed out in firefighter's ensembles (FFE) including one piece coverall, gloves, anti-flash hood, helmet, and steel toed rubber boots. Re-entry teams shall use as a minimum, a single attack 1 1/2" hose, with vari-nozzle and AFFF as the primary firefighting agent. AFFF may be supplied from a balanced pressure proportioner or from 5 gallon cans using an in line eductor. Before the single attack hose enters the space, a second backup attack hose should be manned and charged to render assistance. Supply AFFF for the backup hose from 5 gallon cans using an in-line eductor. Use in-line eductors designed for use with 95 gpm vari nozzles. The primary functions of the re-entry team is to rescue trapped personnel, to ensure the fuel source is secured, to overhaul the fire, and to lay a blanket of foam on any flammable liquids to prevent a reflash. The scene leader shall decide what resources are needed, including the need for an attack team leader with NFTI and/or the need for the backup team to enter the space. If the scene leader directs the backup team to enter the space, enough distance should be maintained between the first and second hoses to prevent maneuverability and firefighting progress from being impaired. The scene leader should consider having the backup hose team attack the fire from a different direction or access. If an additional person is available to act as an attack team leader, he should enter the space in a FFE and direct the actions of the hose team(s). The attack team leader should operate the NFTI to locate and direct the hose team(s) to the fire.

2. In Port

The local fire department (military or civilian) should be familiar with the cutter. Periodic visits should be conducted to acquaint new members of the fire department with the cutter and its fire protection doctrine. A copy of the cutter's fire protection doctrine shall be made available to the fire department and kept up to date by the cutter.

The Coast Guard uses two types of threads in its firemain system: National Standard Hose Threads for 2.5" and larger connections, and National Pipe Straight Hose Threads for 1.5" connections. These threads may not be compatible with municipal fire departments. On cutters which do not have 2.5" topside hose connections, it is necessary to install a 2.5" male by 1.5" female adapter to the International Shore Connection (Ship). All cutters shall ensure that local fire departments have the companion flange to the International Shore Connection (Ship).

The local fire department, and other cutters in port shall be notified of any fire and assistance requested if needed.

E. Post-Extinguishment Actions

Combustible gases may be present after a compartment fire has been extinguished. Carbon monoxide will be the predominant gas generated in a class A or class C fire; substantial concentrations are required (12.5% is the lower flammable limit) before carbon monoxide will ignite. Therefore, after a class A or class C fire, desmoking with installed ventilation equipment can proceed with minimal risk. If the fire involved class B materials, the presence of flammable liquids can create a flammable atmosphere. Operating electric controllers to start ventilation fans may ignite these gases. After a class B fire, the presence of combustible gases should be assumed; desmoking with installed ventilation equipment can proceed with minimal risk under the following conditions:

- The class B fire has been extinguished
- AFFF has been used to cover flammable liquids
- The source of fuel has been secured
- The space has been allowed to cool for at least 15 minutes
- All fuel has been washed into the bilge
- No damage has been sustained to the ventilation equipment
- No damage has been sustained by the ships service generator

If desmoking with the installed ventilation system is prudent, all fans (supply and exhaust) should be operated on high speed for at least 15 minutes. Desmoking shall precede atmospheric testing because combustible gas analyzers will not operate reliably in a halon atmosphere and oxygen analyzers will not operate reliably if the sensor is exposed to excessive moisture, heat or particulate found in a post-fire atmosphere. When the space is tested for oxygen and combustible gases, oxygen shall be between 20 - 22 percent, combustible gases shall be less than 10 percent of the lower explosive limit, and all toxic gases below their threshold limit values before the space can be certified safe to enter without OBA's.

Shipboard personnel authorized to conduct post-fire atmospheric tests for the purpose of certifying the space safe for personnel are gas-free engineers and gas-free petty officers (E-5 and above) as defined by the Naval Ships Technical Manual, Chapter 074, Volume 3. When emergency conditions exist and the gas-free engineer or gas free petty officer are not available, a performance qualification standard (PQS) qualified repair party post fire gas free test assistant may perform testing with the approval of the Commanding Officer. The repair party post-fire gas-free test assistant may not perform "safe for hot work" gas free tests unless he is qualified per the requirements of NSTM 074 vol. 3.

The extent of testing for toxic gases is dependent on the effectiveness of desmoking. When the installed ventilation system is operated on high speed for at least 15 minutes, the only toxic gas test required is for carbon monoxide. If desmoking is accomplished by less effective means, tests are required for carbon monoxide, carbon dioxide, hydrogen chloride, hydrogen cyanide, and hydrocarbons. In addition if halon has

been discharged a test for hydrogen fluoride must be conducted if the installed ventilation system was not operated on high speed for 15 minutes to desmoke.

A compartment is considered safe only after satisfactory test results have been achieved at all test locations during the latest round of tests.

Fire Protection Doctrine - Part C

Procedures for Firefighting on VINDICATOR

Table of Contents

Fire Protection Doctrine - Part C

Procedures for Firefighting on VINDICATOR

I. Introduction

One of the most life threatening and hazardous activities that may be encountered on board ship is fighting a fire. Unlike a building fire, the crew often can not evacuate and leave the firefighting to trained professionals. The crew must extinguish the fire, often without assistance, and using only the available equipment on board. Once a fire occurs, it is too late to read this doctrine, it is too late to obtain training, and it is too late to repair and maintain damage control equipment. Finally, the procedures in this doctrine are not a substitute for the exercise of good judgment based on experience and the particular conditions that exist at the time.

The purpose of this doctrine is to provide useful background information pertinent to fire science (Part A), guidance promulgated by Commandant for "large" classes of Coast Guard Cutters (Part B), and tactical firefighting procedures for each class of fire likely to be encountered on this class of vessel, inport and underway (Part C). Note, the Commanding Officer is responsible for tailoring Part C of this doctrine within the guidelines set forth in the following documents:

- Naval Ships' Technical Manual (NSTM) Chapter 074, Volume 3
- Naval Ships' Technical Manual (NSTM) Chapter 077
- Naval Ships' Technical Manual (NSTM) Chapter 079
- Naval Ships' Technical Manual (NSTM) Chapter 555
- FXP-4
- Surface Ship Survivability, NWP 62-1
- COMDTINST M9000.6B, Naval Engineering Manual
- The Cutter's Fire Protection Doctrine, Parts A and B
- The Cutter's Engineering Casualty Control Manual

II. Vessel Characteristics

The 225' VINDICATOR (WMEC 3) is a Medium Endurance Cutter; its primary mission is Enforcement of Laws and Treaties. The inboard and outboard profile views and plan views of each deck of the VINDICATOR are shown in Figures C.2 through C.6. The legend for symbols on these figures is shown in Figure C.1 and the key to the compartment names are shown in Table C.1. A description of significant fuel loads, installed firefighting systems and access/egress routes for each compartment in the cutter are also provided in this section of the doctrine.

Table C.1 VINDICATOR Compartmentation

Serial Number	Compartment Name	Plan ID Number
	Hold Lower Level	
1	FOREPEAK BALLAST TANK	4-B-0-W
2	BALLAST TANK	4-6-1-W
3	BALLAST TANK	4-6-2-W
4	FUEL OIL TANK	4-12-0-F
5	FUEL OIL TANK	4-12-1-F
6	FUEL OIL TANK	4-12-2-F
7	FUEL OIL TANK	4-18-0-F
8	SPEED LOG XDCR TRUNK	4-24-1-T
9	BALLAST TANK	4-24-2-W
10	BALLAST TANK	4-24-3-W
11	BALLAST TANK	4-24-4-W
12	TRANSDUCER TRUNK	4-31-1-T
13	MAIN GENERATOR RM	3-34-0-E
14	VOID	4-34-1-V
15	VOID	4-34-2-V
16	PROPULSION MTR RM	3-52-01-E
17	POTABLE WATER	3-52-02-W
18	FO SERV TANK	4-52-3-F
19	FO SERV TANK	4-52-4-F
20	AUXILARY POTABLE WATER	3-58-0-W
21	LO TANK	4-60-1-F
22	LO TANK	4-60-2-F
23	OILY WASTE TK	4-66-1-F
24	OILY WASTE TANK	4-66-2-F
25	TUNNEL	3-72-1-L
26	FUEL OIL TANK	4-72-1-F
27	FUEL OIL TANK	4-72-2-F
28	FUEL OIL TANK	4-72-3-F
29	FUEL OIL TANK	4-72-4-F
30	FUEL OIL TANK	4-80-1-F
31	FUEL OIL TANK	4-80-2-F
32	BALLAST TANK	4-86-1-W
33	BALLAST TANK	4-86-2-W
	Hold Upper Level	
35	BOW THRUSTER ELEC MTR RM	2-6-0-E
40	PASSAGE	2-24-0-L
41	LAUNDRY RM	2-24-1-Q
42	LAUNDRY RM	2-24-1A-Q
43	ENGR STRM	2-24-2-A
44	A/C MCHRY SPACE	2-24-4-Q
45	SEWAGE MCHRY RM	2-29-1-Q
46	SEWAGE HOLDING TANK	2-31-1-W
50	MAIN CONTROL STATION	2-52-0-C
58	ANTI-ROLL TANK	2-72-0-W
66	TUNNEL	2-86-1-L
69	STEERING GEAR RM	2-94-0-Q
70	AFTER PEAK BALLAST TANK	3-94-1-W
71	AFTER PEAK BALLAST TANK	3-94-2-W

Table C.1 VINDICATOR Compartmentation (continued)

Serial Number	Compartment Name	Plan ID Number
	Main Deck	
72	STEWARD STOREROOM	1-D-0-A
73	CHAIN LKR	1-6-1-A
74	CHAIN LKR	1-6-2-A
75	DRY PROVISIONS STRM	1-6-3-A
76	SHIP STORE	1-6-4-Q
77	PASSAGE	1-9-0-L
78	PASSAGE	1-9-0A-L
79	PASSAGE	1-9-0B-L
80	FREEZE ROOM	1-14-1-A
81	RECREATION ROOM	1-14-2-L
82	THAW ROOM	1-18-1-A
83	CHILL ROOM	1-18-3-A
84	STWY	1-22-1-L
85	EXERCISE RM	1-22-3-L
86	STWY	2-22-1-L
87	CREWS SR (3)	1-24-2-L
88	CBR LKR	1-28-2-A
89	T/S	1-28-4-L
90	HOSPITAL	1-30-1-L
91	CREWS SR (3)	1-30-2-L
92	T/S	1-32-1-L
93	WARDROOM	1-34-1-L
94	FAN ROOM	1-34-2-Q
95	UPTAKE	1-40-1-T
96	CG LKR	1-40-2-A
97	HALON CYLINDER STWG	1-40-3-A
98	UPTAKE	1-40-4-T
99	BAGGAGE STRM	1-40-6-A
100	GALLEY	1-42-1-Q
101	SCULLERY	1-44-2-Q
102	CREWS SR (6)	1-45-2-L
103	MCHRY ACCESS & REMOVAL TRUNK	1-46-1-T
104	T/S	1-48-2-L
105	CREWS MESSROOM	1-52-1-L
106	CREWS SR (3)	1-54-2-L
107	T/S	1-57-2-L
108	CREWS SR (3)	1-58-2-L
109	DC LKR	1-62-1-A
110	GENERAL WORKSHOP	1-62-3-Q
111	CREWS SR (3)	1-63-2-L
112	T/S	1-66-2-L
113	STWY	1-68-1-L
114	FAN ROOM	1-68-3-Q
115	CREWS SR (3)	1-68-2-L
116	VESTIBULE	1-72-2-L
117	D.C. SHOP	1-75-0-Q

Table C.1 VINDICATOR Compartmentation (continued)

Serial Number	Compartment Name	Plan ID Number
	Main Utility Deck	
124	MAIN DECK UTILITY SPACE NO.2	1A-14-0-Q
125	MAIN DECK UTILITY SPACE NO.1	1A-14-1-Q
128	MAIN DECK UTILITY SPACE NO.3	1A-34-1-Q
129	MAIN DECK UTILITY SPACE NO.4	1A-34-2-Q
134	MAIN DECK UTILITY SPACE NO.5	1A-42-1-Q
136	MAIN DECK UTILITY SPACE NO.7	1A-52-1-Q
	Focsle Deck	
141	BOSUN STORES	01-G-0-A
142	STRM NO 2	01-1-2-A
143	PASSAGE	01-2-0-L
144	STRM NO 1	01-2-1-A
145	EMER SWBD & GEN RM	01-6-0-Q
146	PASSAGE	01-10-0-L
147	PASSAGE	01-10-0A-L
148	PASSAGE	01-10-0B-L
149	CREW SR (2)	01-14-1-L
150	T/S	01-14-2-L
151	CREW SR (2)	01-14-4-L
152	T/S	01-17-1-L
153	CREW SR (2)	01-19-1-L
154	CREW SR (2)	01-21-2-L
155	STAIRWAY	01-22-1-L
157	CREW SR (2)	01-24-1-L
158	T/S	01-26-2-L
159	T/S	01-27-1-L
160	CREW SR (3)	01-28-2-L
161	CREW SR (2)	01-30-1-L
162	T/S	01-34-1-L
163	CREW SR (3)	01-34-2-L
164	VENT TRUNK	01-34-2A-T
165	CREW SR (3)	01-34-3-L
166	SPONSOR STRM	01-40-1-A
169	T/S	01-41-2-L
170	CREW SR (3)	01-44-2-L
171	T/S	01-46-1-L
173	CREW SR (3)	01-47-1-L
174	COMMUNICATION CTR	01-54-1-C
175	VESTIBULE	01-54-2-L
176	CG LKR	01-54-4-A
177	T/S	01-54-6-L
178	PASSENGER BERTHING (6)	01-57-2-L
179	TRAINING RM/ CREWS LOUNGE	01-61-0-L
180	PASSAGE	01-61-2-L
181	ARMORY/LAW ENFORCE. CENTER	01-64-2-K
182	ELECTRONICS & ELECTRICAL SHOP	01-68-0-Q
183	HYD. POWER RM.	01-69-1-Q

Table C.1 VINDICATOR Compartmentation (continued)

Serial Number	Compartment Name	Plan ID Number
	Focsle Utility Deck	
184	FCSLE DECK UTILITY SPACE NO.1	01A-14-1-Q
185	FCSLE DECK UTILITY SPACE NO.2	01A-14-2-Q
188	FCSLE DECK UTILITY SPACE NO.4	01A-34-0-Q
189	FCSLE DECK UTILITY SPACE NO.3	01A-34-1-Q
193	FCSLE DECK UTILITY SPACE NO.5	01A-54-1-Q
194	FCSLE DECK UTILITY SPACE NO.6	01A-54-2-Q
	Upper Deck	
195	T/S	02-14-1-L
196	EO SR	02-14-2-L
197	CO SR	02-14-3-L
198	T/S	02-18-2-L
199	PASSAGE	02-20-0-L
201	SHIP'S OFFICE & SUPPLY OFFICE	02-22-1-Q
202	XO SR	02-22-2-L
203	STAIRWAY	02-25-1-L
204	T/S	02-27-2-L
205	OFFICERS SR (2)	02-30-1-L
206	OFFICERS SR (2)	02-30-2-L
207	HW HTR LKR	02-32-2-Q
208	T/S	02-33-1-L
209	T/S	02-33-2-L
211	OPS. OFF. SR (2)	02-35-1-L
212	T/S	02-36-1-L
213	FIRST LT. SR (2)	02-37-2-L
216	T/S	02-41-2-L
217	FAN RM	02-42-1-Q
218	CG LKR	02-42-2-A
	Upper Utility Deck	
219	UPPER DECK UTILITY SPACE NO.1	02A-14-0-Q
220	UPPER DECK UTILITY SPACE NO.2	02A-22-1-Q
	Bridge Deck	
226	PILOT HOUSE	03-15-0-C
227	TOILET	03-28-1-L

Symbol	Description
▬	Door/Window
□	Hatch (in overhead)
○	Scuttle (in overhead)
X	XRAY - rated
Y	YOKE - rated
Z	ZEBRA - rated
W-NC	Window normally closed
NC	Door normally closed
DO	Open Doorway
Unrated hatch is open hatchway	

Figure C.1 Symbol Legend

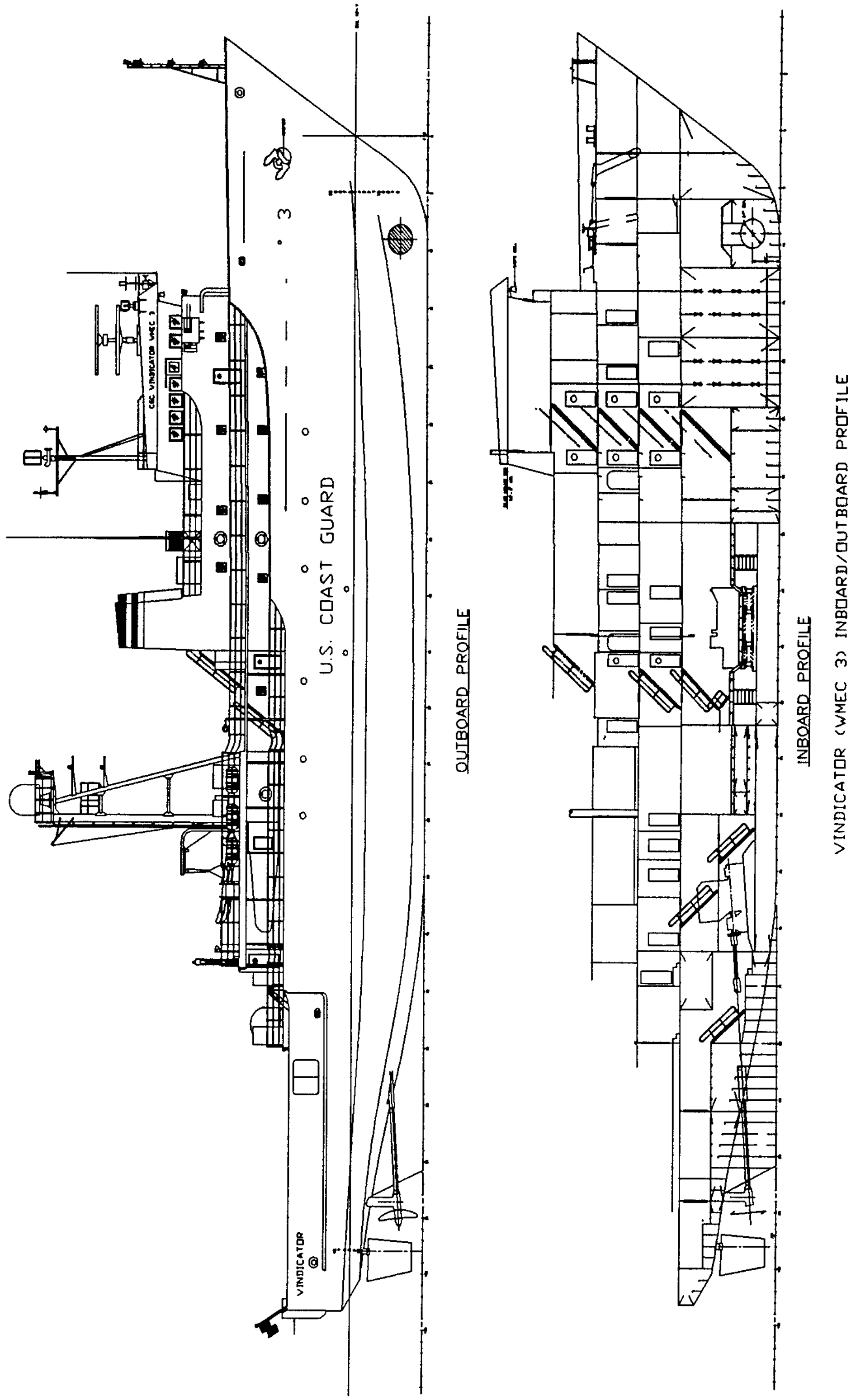

Figure C.2 VINDICATOR Inboard and Outboard Profile

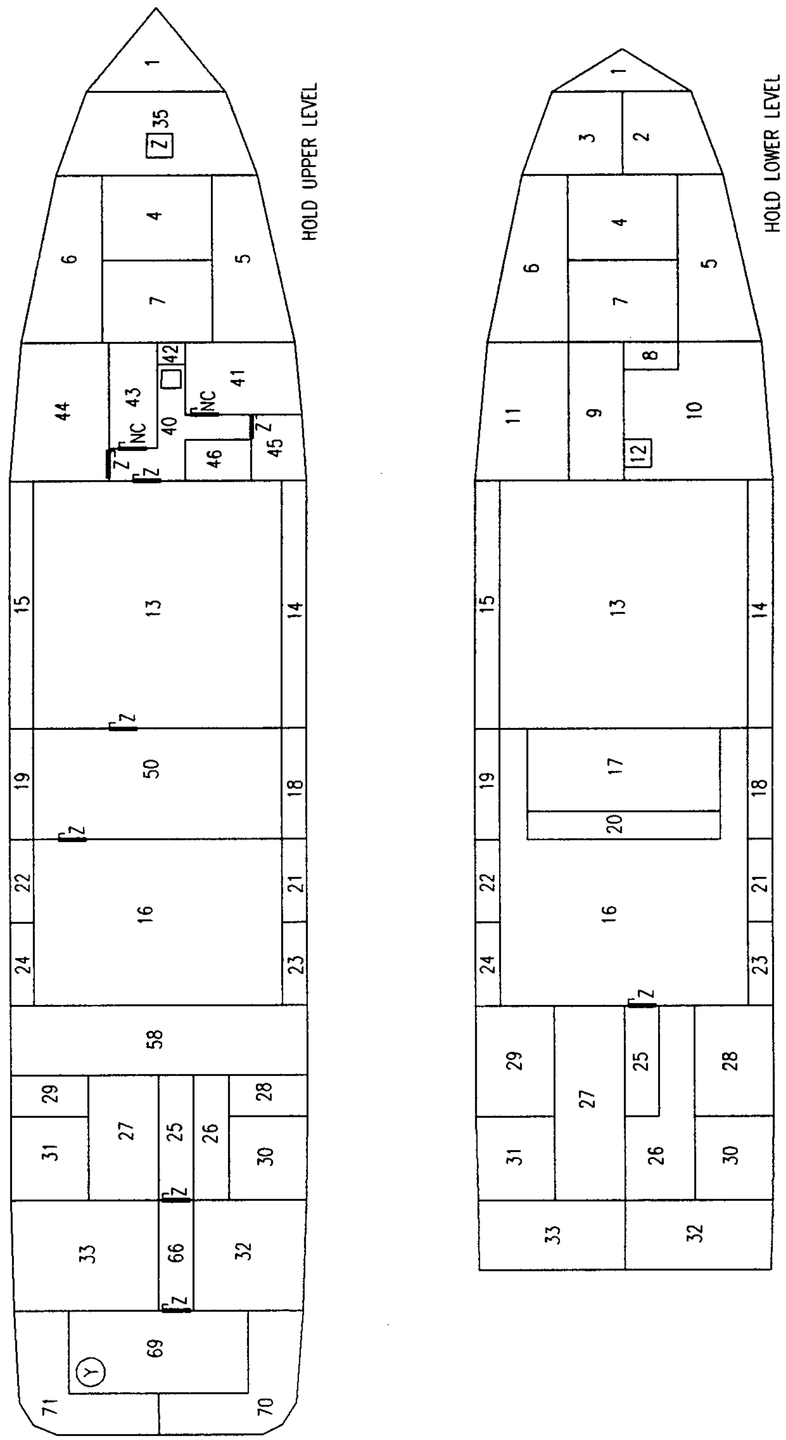

Figure C.3 VINDICATOR Hold Lower Level and Hold Upper Level

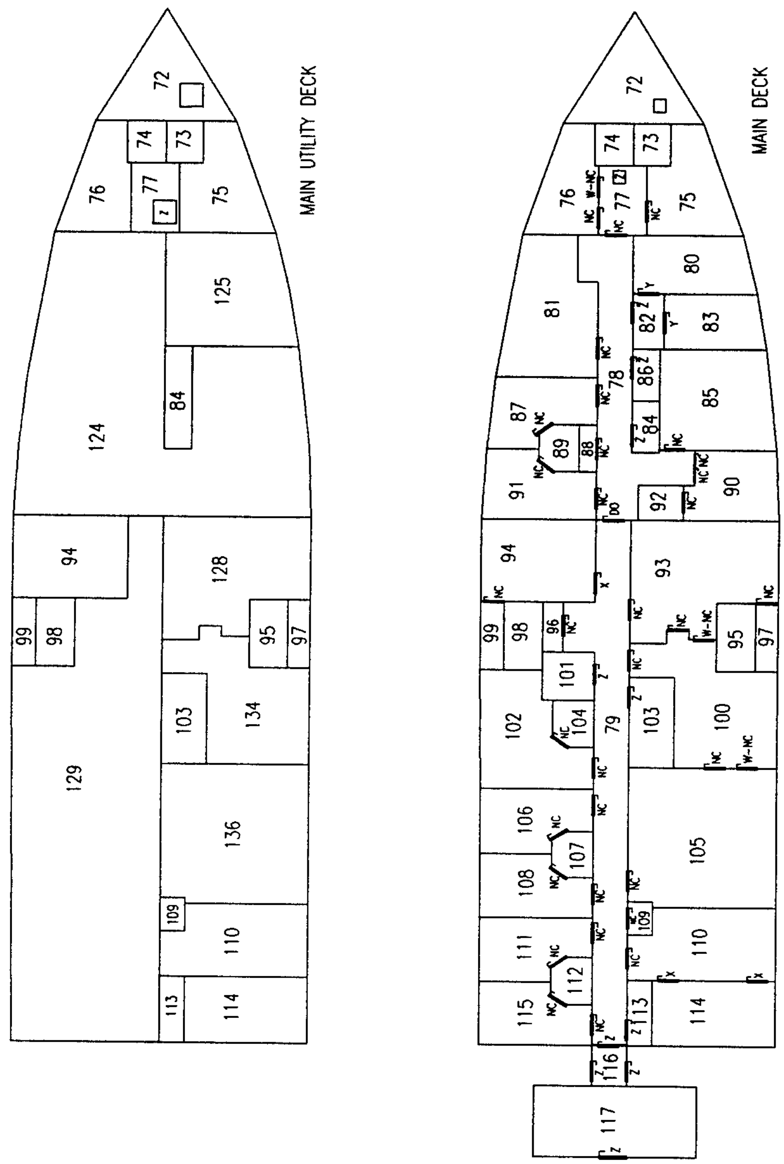

Figure C.4 VINDICATOR Main Deck and Main Utility Deck

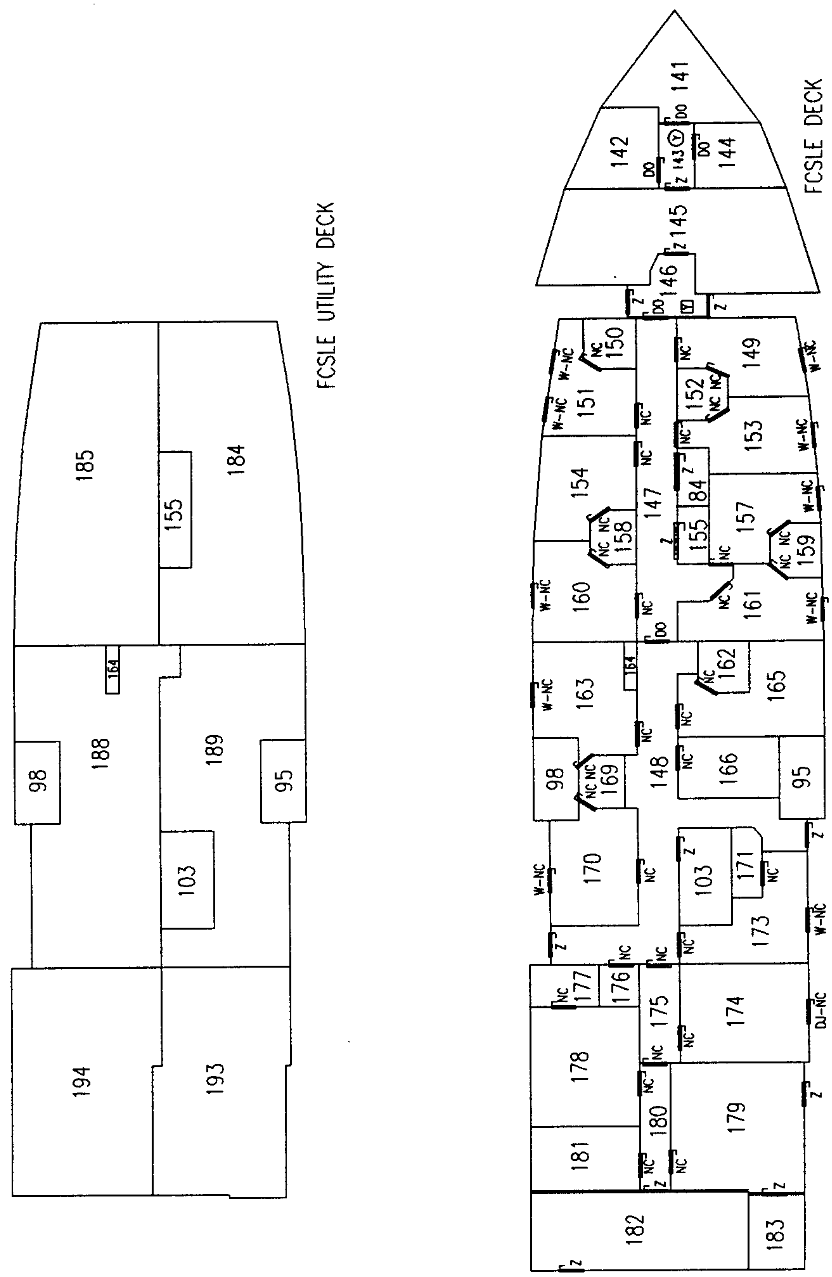

Figure C.5 VINDICATOR Fcsle Deck and Fcsle Utility Deck

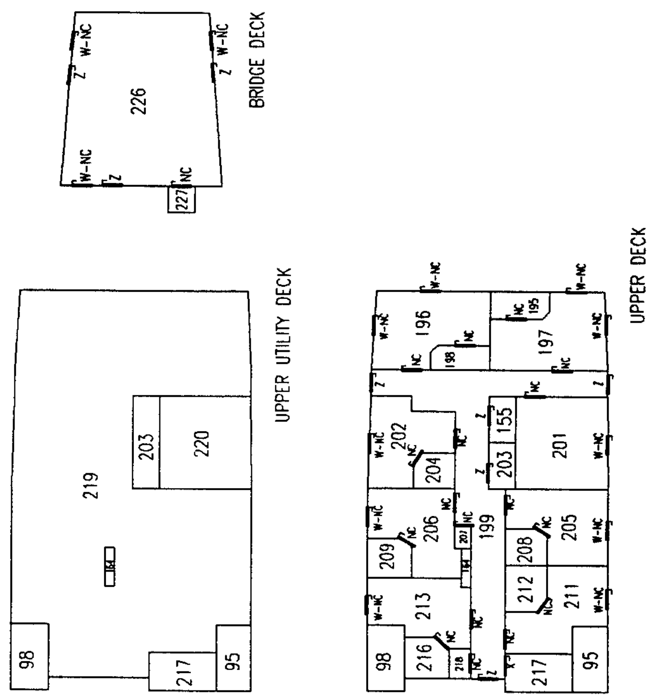

Figure C.6 VINDICATOR Upper Deck, Upper Utility Deck and Bridge Deck

A. Compartmentation

1. Below the Main Deck

Below the main deck, the cutter is divided into the following ten areas, each separated by a steel watertight bulkhead:

(a) Forepeak

The Forepeak Tank is located forward of frame 6 below the Steward's Storeroom; it is inaccessible and contain no combustible materials.

(b) Bow Thruster Room

The Bow Thruster Electric Motor Room, located between frames 6 and 12, contains a controller and electric motor for the bow thruster located in a tunnel running athwartships. The Bow Thruster Room is protected by an installed Halon 1301 total flooding system.

The only access to this space is from the Main Deck Passageway through a watertight hatch in the overhead and down a vertical ladder.

(c) Fuel Tanks

Four fuel tanks occupy the area between frames 12 and 24. They are inaccessible and not considered in the fire safety analysis of this cutter.

(d) A/C Machinery Space, Engineers Stores, Laundry and Sewage Machinery Room

These four compartments are located between frames 24 and 34. The A/C Machinery Space and Engineer's Storeroom are accessible from the centerline passageway on the port side. The Sewage Machinery Room and Laundry Room are accessible from the centerline passageway on the starboard side. This passageway is accessible from the Main Generator Room via a watertight door in the aft bulkhead (frame 34) and from an inclined ladder in the forward part of the passageway that leads up to the Main Deck Passageway through a joiner door at the top of the ladder.

(e) Main Generator Room

The Main Generator Room occupies the entire space between frames 34 and 52 except for small voids outboard on the port and starboard sides. This compartment also spans two deck levels. It contains the four main diesel generator sets which provide the electrical power for the ship including the two main propulsion motors located in the Propulsion Motor Room. The diesel engines exhaust through the port and starboard uptakes. The #1 fire pump is located in this space at frame 50 starboard side aft in the space. This space is protected by a Halon 1301 total flooding system.

There are three accesses to the Main Generator Room:

- forward through a watertight door on the centerline to the centerline passageway
- aft through a watertight door on the port side to the Main Control Station

• up to the Main Deck Passageway via an inclined ladder and through a joiner door at the top of the ladder.

(f) Main Control Station

The Main Control Station contains the Main Engine Control Console and Main Switchboard and occupies the area between frames 52 and 60.

There are two accesses to the Main Control Station:

- forward through a watertight door on the port side to the Main Generator Room
- aft through a watertight door on the port side to the Main Motor Room.

(g) Main Motor Room

The Motor Room spans two levels and contains the two main propulsion motors. On the lower level it extends from the aft bulkhead of the Main Generator Room, frame 52 aft to frame 72. On the upper level it extends from the aft bulkhead of the Main Control Station, frame 60 aft to frame 72. It is protected by an installed Halon 1301 total flooding system. In addition, each Main Motor is protected by a separate and independent CO_2 flooding system which discharges directly into the affected motor casing. The #2 fire pump is located in this space at frame 65 on the port side.

Inaccessible Fuel Oil Service Tanks, Lube oil Tanks, and Oily Waste Tanks are located outboard on the port and starboard sides. In addition, two large fresh water storage tanks are located on the centerline, forward on the lower level of the Main Motor Room.

There are three accesses to the Main Motor Room:

- forward through a watertight door on the port side to the Main Control Station
- aft through a watertight door on the starboard side to a Tunnel that leads to the Steering Gear Room
- up through the Machinery Access and Removal Trunk via an inclined ladder and through a joiner door at the top of the ladder to the Main Deck Passageway.

(h) Tunnel

The Tunnel that connects the Main Motor Room with the Steering Gear Room is actually two segments connected by a short inclined ladder and a watertight door at frame 86. The tunnel is used for storage of 5-gallon cans of various hydraulic and lube oils. The forward segment extends from the aft bulkhead of the Main Motor Room aft to frame 86. The aft segment extends from frame 86 aft to frame 94, the forward bulkhead of the Steering Gear Room.

Six fuel oil storage tanks are located outboard on the port and starboard sides of the Tunnel.

There are two accesses to the Tunnel:

- forward through a watertight door on the starboard side to the Main Motor Room.

- aft through a watertight door on the starboard side to the Steering Gear Room.

(i) Steering Gear Room

The Steering Gear Room is located aft of frame 94 and contains the hydraulic steering gear equipment. Normal egress is through the watertight door on the starboard side forward to the Tunnel. Emergency egress is provided via a vertical ladder through an escape scuttle to the Main Weather Deck.

2. The Main Deck

Compartments on the Main Deck and above generally utilize marine plywood as joiner paneling. The plywood panels in most cases extend to the height of the celotex dropped ceiling panels. Thus large utility void spaces are created which encompass several compartments on each deck level. These void spaces are shown in Figures C.4 through C.6.

The following are located aft on the Main Weather Deck, exterior to the superstucture:

- Oil Spill Containment Locker, frame 73, starboard side, aft of the Fan Room
- AFFF Locker, port and starboard, frame 76
- Barrel Racks for oil drum storage, port and starboard, frame 87,
- 50 Cal machine gun mounts and XBT launchers, frame 101, port and starboard
- Ready Service Box with ammunition, frame 81, starboard side
- Oxygen Bottle Stowage Rack, frame 81, port side
- Portable Fire Pump Locker with two P-250 Mod 1 pumps, frame 73, port side
- Potable Hose Locker, frame 75, port side
- Fire Pump Hose Locker, frame 73, port side

Most of the compartments on the Main Deck are accessed from the longitudinal passageway that extends almost the entire length of the Main Deck superstructure. The master fire and smoke alarm test panel, ventilation remote shutoffs, and remote fuel and lube oil shutoffs are located in this Passageway at frame 64. Various power panels, OBA stowage lockers, and first aid kit are also located in this Passageway as well as a firemain station. AFFF is stowed under the grating of the inclined ladder in the Vestibule at the aft end of the Main Deck Passageway.

The following is a brief description of the fuel loads, compartmentation, on the Main Deck including access routes and installed automated fire extinguishing systems:

(a) Steward's Storeroom

The Steward's Storeroom is the forward most compartment on the Main Deck. Open shelving on the port and starboard sides permit storage. Access to this compartment is through a large hinged grating in the deck of the Storeroom #1 above.

(b) DC Shop

This compartment is the after most compartment on the Main Deck. It contains a welder, workbench, tools in lockers, Halon cylinders, and the stern tube lube oil head tank. On the Main Weather Deck and against the aft bulkhead of the DC Shop is the ready service box which stores the ammunition for the 50 cal. machine guns, in addition oxygen cylinders are stowed in a rack against this bulkhead. Access to this compartment is through a watertight door in the after bulkhead from the Main Weather Deck.

(c) Port and Starboard Sides

The compartments shown in Tables C.2 and C.3 are on the starboard and port sides respectively of the longitudinal Main Deck Passageway listed in order from forward to aft. With the exceptions noted, all compartments are accessible from the Main Deck Passageway through joiner doors.

Table C.2 Main Deck Compartments - Starboard Side

Compartment Name	Significant Fuel Loads	Remarks
Dry Provisions Storeroom	Packaged food and Galley stores	
Freeze Room	Frozen food	Accessible only from Thaw Room
Chill Room	Fruits, vegetables and produce	Accessible only from Thaw Room
Thaw Room	Frozen food	
Exercise Room	Punching bag, treadmill, exer-cycle, exercise mats, misc benches	
Hospital	Medical supplies in cabinets, oxygen bottles, one bed with linens/blankets	
Wardroom	Table & 8 chairs, sofa, stereo/TV, toaster oven, coffee maker, refrigerator	Also accessible from Galley
Halon Cylinder Storage	Halon & CO_2 cylinders	Accessible only from Wardroom
Galley	Deep fat fryer and griddle (protected by APC fire ext. system), food mixer, electric kettle, slicer, pots and pans stowed in cabinets, refrigerator/freezer, dresser with sinks, microwave oven	Also accessible from Crews Messroom and Wardroom.
Crews Messroom	Toaster, two settees, 17 chairs, 6 tables, juice dispenser, TV, milk dispenser, ice maker, coffee urn,	Also accessible from Galley
DC Locker	Full allowance of damage control & firefighting equipment for WMEC	
General Workshop	Grinder, drill press, bandsaw, workbench and cabinets with tools, lathe, hydraulic press, arc welder, lighting test panel	
Fan Room	Ductwork, preheater coils, vent fans	Accessible only from General Workshop

Table C.3 Main Deck Compartments - Port Side

Compartment Name	Significant Fuel Loads	Remarks
Ship Store	Candy, toiletries, and personal products on open shelves	
Recreation Room	Soda dispenser, stereo/TV, magazine rack, 3 lounge chairs, table with 4 side chairs, end table and lamp	
Crews Stateroom (2) 1-24-2	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (2) 1-29-2	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
Fan Room, 1-34-2	Ductwork, preheater coils, vent fans	
Baggage Storeroom	Seabags, clothing	Accessible only from Fan Room 1-34-2
Trash Storage Room	Hot water heater, sink	
Scullery	Dishwasher, trash compactor, sink	
Crews Stateroom (3) 1-49-2	Triple berth, lockers and personal effects for three crewmembers	
Crews Stateroom (3) 1-53-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (3) 1-58-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (3) 1-63-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (3) 1-67-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower

3. The Focsle Deck (01 Deck)

The following are located aft on the 01 Weather Deck, exterior to the superstucture:

- Freon cylinders, frame 12, port and starboard, aft of the Emergency Switchboard and Generator Room
- Oxygen cylinders, frame 15, starboard side
- Freon cylinders, frame 15, port side
- Acetylene cylinders, frame 21, port side

- Gasoline stowage remote release, frame 64, starboard side
- Deck gear locker, frame 73, starboard side

Most of the compartments on the 01 Deck are accessed from the longitudinal passageway that extends almost the entire length of the 01 Deck superstructure. A stokes litter, various power panels, bulletin boards and a first aid kit are located in this Passageway as well as a firemain station.

The following is a brief description of the fuel loads, compartmentation, on the 01 Deck including access routes and installed automated fire extinguishing systems:

(a) Bosun's Storeroom

The Bosun's Storeroom is the forward most compartment on the 01 Deck. Open shelving on the port and starboard sides permit storage. Access to this compartment is through an expanded metal door from the Passageway forward of the Emergency Switchboard and Generator Room. This storeroom is separated from the Storeroom #1 located aft on the starboard side by an expanded metal bulkhead.

(b) Storeroom #1

Open shelving on the aft bulkhead permits storage. Access to this compartment is through an expanded metal door from the Passageway forward of the Emergency Switchboard and Generator Room.

(c) Storeroom #2

Open shelving on the forward bulkhead permits storage. Access to this compartment is through a joiner door from the Passageway forward of the Emergency Switchboard and Generator Room.

(d) Emergency Switchboard and Generator Room

This compartment extends from frame 6 to frame 12 and is isolated from the majority of the compartments in the 01 Deck superstructure. It contains the emergency generator and associated switchboard, a hydraulic power unit, and spare parts stowage. It is protected by a Halon 1301 total flooding system. Normal access is through a watertight door in the aft bulkhead to a passageway. This passageway provides egress to weather on both port and starboard sides and aft to the longitudinal 01 Deck Passageway in the superstructure. Emergency egress is available through a joiner door to the passageway forward and then through an emergency escape scuttle in the overhead of this passageway to the 02 weather deck.

(e) Port and Starboard Sides

The compartments shown in Tables C.4 and C.5 are on the starboard and port sides respectively of the longitudinal 01 Deck Passageway listed in order from forward to aft. With the exceptions noted, all compartments are accessible from the 01 Deck Passageway through joiner doors.

Table C.4 01 Deck Compartments - Starboard Side

Compartment Name	Significant Fuel Loads	Remarks
Crews Stateroom (2) 01-14-1	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (2) 01-18-1	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (2) 01-23-1	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (2) 01-29-1	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (2) 01-34-1	Double berth, lockers and personal effects for two crewmembers	
Sponsor Storeroom	Shredder, miscellaneous storage on open shelves	
Crews Stateroom (2) 01-47-1	Double berth, lockers and personal effects for two crewmembers	
Communication Center	Electronic equipment in racks	Also accessible via escape scuttle to 01 Weather Deck, starboard side
Training Room/Crew's Lounge	3 Sofas, table and 4 chairs, TV, end table with lamp	
Hydraulic Power Room	Hydraulic power unit	Accessible only from Training Room/Crews Lounge. Protected by a Halon 1301 total flooding system

Table C.5 01 Deck Compartments - Port Side

Compartment Name	Significant Fuel Loads	Remarks
CPO Stateroom (2) 01-14-4	Double berth, lockers and personal effects for two crewmembers	
CPO Stateroom (2) 01-21-2	Double berth, lockers and personal effects for two crewmembers	Also accessible from shared toilet/shower
CPO Stateroom (3) 01-27-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (3) 01-34-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower
Crews Stateroom (3) 01-43-2	Triple berth, lockers and personal effects for three crewmembers	Also accessible from shared toilet/shower
Passenger Berthing (6) 01-56-2	Two triple berths, lockers and personal effects for six passenger	
Armory/Law Enforcement Center	Small arms locker, workbench shelves for open storage	
Electronics and Electrical Shop	Workbench and tools, lighting test panel	Also accessible from 01 weather deck through watertight door, frame 73, port side. Protected by Halon 1301 total flooding system

4. The Upper Deck (02 Deck)

The following are located aft on the 02 Weather Deck, exterior to the superstucture:

- Survival Gear Locker, frame 45, starboard side, aft of the Uptake
- Deck Gear Locker, frame 45, starboard side, aft of the Fan Room
- Emergency Radio in a watertight emclosure, frame 45, starboard side, aft of the Fan Room
- Two Flammable Liquid Lockers, Frame 44, port side aft of the Officer's stateroom. Each of these lockers is equipped with a Halon 1301 total flooding system
- Gasoline stowage, frame 64, starboard side

A longitudinal passageway connects with an athwartships passageway on the 02 Deck. All compartments on the 02 Deck are accessed from this passageway. A stokes

litter, various power panels, bulletin boards and a first aid kit are located in this Passageway as well as a firemain station.

A brief description of the fuel loads, compartmentation, and access routes for all compartments on the 02 Deck are shown in Table C.6 listed in order from forward to aft. With the exceptions noted, all compartments are accessible from the 02 Deck Passageway through joiner doors.

Table C.6 02 Deck Compartments

Compartment Name	Significant Fuel Loads	Remarks
Commanding Officer's Stateroom 02-14-3	Single berth, lockers and personal effects for one officer, safe, key locker, refrigerator,desk, settee with end table and lamp	
Executive Officer's Stateroom 02-14-2	Single berth, lockers and personal effects for one officer, refrigerator,desk, chair with end table and lamp	
Ship's Office and Supply Office	File Cabinets, computer, printer, microfiche reader, stationary supplies in cabinet, two desks with lamps and chairs, copy machine	
Operations Officer's Stateroom 02-22-2	Single berth, locker and personal effects for one officer, desk and chair, refrigerator	
Engineer Officer's Stateroom 02-29-2	Single berth, locker and personal effects for one officer, desk and chair, refrigerator	
Officer's Stateroom (2) 02-29-1	Double berth, lockers and personal effects for two officers, desk and chair, refrigerator	
Officer's Stateroom (2) 02-35-1	Double berth, lockers and personal effects for two officers, desk and chair, refrigerator	
Officer's Stateroom (2) 02-36-2	Double berth, lockers and personal effects for two officers, desk and chair, refrigerator	
Fan Room 02-42-1	Ductwork, preheater coils and vent fans	

5. The Bridge Deck (03 Deck)

The following are located aft on the 03 Weather Deck, exterior to the superstucture:

- Pyrotechnics Locker, frame 30, starboard side, aft of the Bridge
- Battery and associated charging system, frame 30, port side, aft of the Bridge

The Bridge is the only compartment on the 03 Deck. It contains consoles, chart tables and various electronic equipment such as radars, communications gear, lighting

panels and the remote fire and smoke alarm panel. Access to the Bridge is through watertight doors port, starboard and aft.

B. Diesel Engine Fuel Shutoffs

There are four main diesel generators in the Main Generator Room and an emergency diesel generator in the Emergency Switchboard and Generator Room. Presently, a remote fuel shutoff for the Emergency Diesel Generator does not exist. Remote fuel shutoffs for the Main Diesel Generators are located in the deck, on the port side of the Main Deck Passageway, as shown in Table C.7. All five diesel engines are also shut down electrically in conjunction with the discharge of the installed Halon 1301 total flooding systems for these spaces. A remote fuel shut-off for the Emergency Diesel Generator may be installed as part of the conversion from a T-AGOS class vessel. The location and operation of this remote shutdown is thus {TBD}.

Table C.7 Remote Fuel Shutoffs for Main Diesel Generators

Location of Fuel Valve	Location of Remote Shut-Off Deck Box Locations	Function
3-57-3	Frame 63, 1-9-0-L, stbd side	Stbd F/O Return to Svc Tank
3-57-4	Frame 69, 1-9-0-L, port side	Port F/O Return to Svc Tank
3-58-1	Frame 64, 1-9-0-L, port side	Stbd F/O Supply to SSDG
3-58-2	Frame 68, 1-9-0-L, port side	Port F/O Supply to SSDG

C. Ventilation

Remote shutdowns for ventilation fans are located in the Main Deck Passageway, starboard side, Frame 67-68, below the fire pumps remote actuation panel. The vent fans/power panels affected and spaces served are shown in Table C.8. There are seven remote trips, they are numbered from forward to aft in Table C.8.

D. Fire Detection Equipment

The fire and smoke detection system is a "Pyrotronics, System 3". The location of the master alarm panel is in the Main Deck Passageway, starboard side, Frame 69. The panel consists of two units; a Fire Indicating Unit and a Zone Indicating Unit with both units installed in the same enclosure. The location of the remote alarm panel is on the Bridge, port side. In the event of a detected fire, the Fire Indicating Unit does the following:

- Energizes a red alarm light and buzzer at the master and remote panels
- Activates an alarm bell and blue rootating beacon light in the Vestibule at the after end of the Main Deck Passagway.
- Sends a signal to the Main Control Station

Table C.8 Remote Shutoffs for Ventilation Fans

Location of Remote Trip	Secures	Serves
Station #1, Frame 67, 1-9-0-L, port side	Supply Fan 01-40-2	Main Generator Room
Station #2, Frame 67, 1-9-0-L, port side	Supply Fan 01-40-1	Main Generator Room
Station #3, Frame 67, 1-9-0-L, port side	Supply Fan 3-71-2	Propulsion Motor Room
Station #4, Frame 67, 1-9-0-L, port side	HVAC Panel P-410, 02-25-0	Pilothouse A/C Unit 04-22-2, Recirc Fan 02-43-1 (02 and 03 decks)
Station #5, Frame 68, 1-9-0-L, port side	HVAC Panel P-411, 1-55-0	Array/Winch Shop A/C Unit, 1-76-1, Recirc Fan 1-68-1 (Surtass Ops Ctr), Exhaust Fan 1-70-1 (Surtass Ops Ctr), Exhaust Fan 2-24-1 (Laundry)
Station #6, Frame 68, 1-9-0-L, port side	HVAC Panel P-412, 2-72-0	Recirc Fan 2-55-2 (Mn Control Sta), Recirc Fan 2-59-1 (Mn Control Sta), Supply Fan 2-71-2 (Prop Motor Rm), Supply Fan 2-94-1 (Steering Gr Rm)
Station #7, Frame 68, 1-9-0-L, port side	HVAC Panel P-427, 1-16-0	Supply Fan 2-32-2 (A/C Machy Rm and Engs Strm), Recirc Fan 1-37-2 (All Strms 01 level and all spaces Main Deck), Supply Fan 1-35-4 (Fwd Strms, Emerg Gen Rm, Bow Thruster Rm, & Sewage Machy Rm)

The Zone Indicating Unit identifies the compartment on the master and remote panels by illuminating the appropriatte zone indiacting light. The alarm signals at the Main Control Station are summary alarms with the signal being passed on to the Trouble and Assistance alarm panels. The Fire Indicating Unit will also activate a buzzer alarm abd energize an amber trouble indicating light at the master and remote panels in the event of a malfunction in any of the supervised circuits.

Fire detectors in the system provide fire protection by sensing the products of combustion (visible and invisible smoke or heat). Eleven compartments are protected by the system. Three of these eleven compartments have additional protection in the form of

Manual Fire Station pull handles located outside the compartments served. The quantity, type, and location of the detectors presently installed in the VINDICATOR are shown in Table C.9. Since Coast Guard regulations require additional smoke detectors in Sick Bay and Berthing Areas, additional fire/smoke detectors may be installed as part of the conversion from a T-AGOS class vessel. The quantity, type, and location of these additional detectors is thus {TBD}.

Table C.9 Fire/Smoke Detectors

Zone	Compartment	Location	Type	Quant.
1	Storeroom #2	01-1-2-A	Thermal-190°	1
2	Bosuns Storeroom	01-G-0-A	Ionization	1
3	Emergency Generator Rm	01-6-0-Q	Ionization	1
4	Dry Provisions Storeroom	1-6-3-A	Ionization	1
5	Galley	1-42-1-Q	Ionization	1
6	Bow Thruster Room	2-6-0-E	Ionization	1
7	Engineers Storerrom	2-24-2-A	Ionization	1
8	Main Generator Room	3-34-0-E	Thermal -200°	2
		2-22-1 (Passageway)	Manual Fire Pull	1
		1-45-1 (Ladder)	Manual Fire Pull	1
9	Main Control Station	2-52-0-C	Ionization	1
		2-52-0 (Mn Gen Rm)	Manual Fire Pull	1
		2-62-2 (Prop Mtr Rm)	Manual Fire Pull	1
10	Propulsion Motor Room	3-52-01-E	Ionization	4
		1-70-0 (Ladder)	Manual Fire Pull	1
11	Steering Gear Room	2-94-0-Q	Ionization	1

E. Firefighting Equipment

1. Firemain Stations

•The firemain system is a dry system and energized by one or both fire pumps in the event of a fire. The two fire pumps are also used for ballasting operations. Each of the centrifugal fire pumps is driven by a 20 HP electric motor and has a discharge capacity of 175 gpm. Each pump has motor driven operated suction and discharge valves located near the pumps. The motor operated valves have three modes of operation:

- Manual operation by disengaging motor
- Local electrical operation from the pump controller
- Remote electrical operation

The fire/ballast pump local controller determines the mode of operation by the position of the FIRE/OFF/BALLAST mode selector switch. In FIRE mode the pump cannot be started at any station unless the motor operated suction valve is open and the motor operated discharge valve is closed. Once the pump is operating the discharge valve may be opened.

The #1 Fire/Ballast pump is located in the Main Generator Room, frame 50 starboard side. The #2 Fire/Ballast pump is located in the Propulsion Motor Room, frame 65 port side. Both pumps and their associated motor-operated valves can be operated from the local controller, the fire control station in the Main Deck Passageway, frame 69, starboard side, and the Ship's Control Console in the Pilothouse.

There are 16 firemain stations configured for water and/or AFFF as shown in Table C.10, located throughout the cutter to facilitate a two-hose attack in all compartments.

2. Main Motor CO_2 Flooding System

The two main motors in the Propulsion Motor Room are protected by independent installed CO_2 flooding systems. The systems provide fire protection by discharging CO_2 directly into the motor housing. A pressure switch installed in the CO_2 piping will deactivate the respective motor power supply, resulting in the loss of that motor when the system is activated. Each motor is served by one CO_2 cylinder which contains 35 pounds of agent. The cylinders are located on the upper level of the Motor Room adjacent to the motors. Each system can be activated locally at the cylinder or remotely by operation of the pull handle installed on the after bulkhead of the Main Control Station, frame 60 port side.

CAUTION: There is no time delay after actuating the CO2 flooding system and before discharge of the agent. Therefore it is preferable to activate the system from the Main Control Station. If the system is activated locally, immediately evacuate the space and DO NOT BREATHE until you have exited the Motor Room and secured the door to the space. Do not reenter the space without self contained breathing apparatus.

Table C.10 Firemain Stations

Fire Station No.	Location	Type
1	02 Weather Deck, Frame 14, Stbd Side	Water
2	02 Deck Passageway, Frame 20, Centerline	Water
3	02 Deck Passageway, Frame 41, Port Side	Water
4	01 Deck Passageway, Frame 19, Port Side	Water/AFFF
5	01 Deck Passageway, Frame 43, Port Side	Water
6	01 Weather Deck, Frame 47, Port Side	Water
7	01 Weather Deck, Frame 48, Stbd Side	Water
8	Main Deck Passageway, Frame 33, Stbd Side	Water/AFFF
9	Main Deck Passageway, Frame 70, Stbd Side	Water
10	Main Weather Deck, Frame 72, Port Side	Water
11	Main Weather Deck, Frame 72, Stbd Side	Water
12	Main Generator Room, Frame 34, Centerline	Water/AFFF
13	Main Generator Room, Frame 52, Centerline	Water/AFFF
14	Propulsion Motor Room, Frame 60, Stbd Side	Water/AFFF
15	Propulsion Motor Room, Frame 72, Centerline	Water
16	Tunnel, Frame 83, Stbd Side	Water

3. Halon 1301 Total Flooding Systems

The Main Generator Room, Emergency Switchboard and Generator Room, Hydraulic Power Room and Electronics and Electrical Shop, Bow Thruster Electric Motor Room, Propulsion Motor Room, and Paint Lockers are protected by independent installed Halon 1301 total flooding systems. These systems are capable of flooding each of these spaces once (one-shot systems). Each system consists of at least one Halon 1301 cylinder, a 50 pound cylinder of CO_2, a 30 second time delay device, at least one siren in the protected space and pull handles to activate the system. The primary function of the CO2 cylinder is to provide the required pressure to open the pneumatically operated valves at the Halon 1301 cylinders via the 30 second time delay and to operate the sirens. In addition, the CO2 cylinder provides the pressure to to activate pressure switches that will shut down certain operating equipment in the protected spaces. The pressure switches must be manually reset prior to operation of the interlocked equipment. The location of actuation devices for each system and equipment that is automatically secured are shown in Table C.11.

Table C.11 Halon 1301 Total Flooding Systems

Protected Space	Location of Primary Release	Location of Alternate Releases	Automatic Shutdowns
Main Generator Room, 3-34-0-E	Passageway 1-9-0-L, Frame 39, Centerline	Passageway 1-9-0-L, Frame 67, Centerline and Passageway 2-24-0-L, Frame 32, Port Side	All Four Main Generators Supply Fans 01-40-1 and 01-40-2
Hydraulic Power Room, 01-69-1-Q and Electronics and Electrical Shop, 01-68-0-Q	01 Weather Deck, Frame 73, Port Side	01 Weather Deck, Frame 65, Stbd Side and 01 Weather Deck, Frame 68, Port Side	Supply Fan 1-34-2 and Recirc Fan 1-86-1
Emergency Switchboard and Generator Room, 01-6-0-Q	Passageway, 01-10-0-L, Frame 11, Port Side		Emergency Diesel Generator and Supply Fan 1-35-4
Bow Thruster Electric Motor Room, 2-6-0-E	Passageway, 1-9-0-L, Frame 13, Stbd Side		Supply Fan 1-35-2
Propulsion Motor Room, 3-52-01-E	Main Control Station, 2-52-0-C, Frame 60, Port Side		Supply Fan 3-71-2
Paint Lockers, 02-44-2	02 Weather Deck, Frame 44, Port Side	Automatic due to temp rise in lockers	

4. P-250 Mod 1 Pump

Two P-250 Mod 1 pumps are stowed in the portable fire pump locker on the Main Weather Deck, frame 73, port side. The portable gasoline cans for these pumps are stowed on the starboard side of the 02 Weather Deck. A remote release to jettison the gasoline over the side is located on the starboard side of the 01 Deck.

5. Portable Fire Extinguishers

Presently the existing portable extinguishers have been removed from the vessel to prevent loss during the conversion project. It is presumed that adequate quantities and types of authorized portable extinguishers will be installed in conjunction with the

conversion project. The exact location and type of portable fire extinguishers is thus {TBD}.

6. Protective Equipment

{Quantity TBD} Navy Type A-4 oxygen breathing apparatus (OBA) and {Quantity TBD} firefighting ensembles (FFE) are stowed in the cutter. There are {Quantity TBD} canisters per OBA. The location of OBA's and FFE's are TBD.

III. Firefighting Procedures

In this section 22 different shipboard fire scenarios are described. The recommended procedures for fighting each fire are detailed, from the alarm through post-fire activities. The last procedure is for fires in port.

A. Pilothouse

1. Scenario

The most likely fire in this compartment is a class C fire in energized electronic or electrical equipment such as the radar. There is also a significant possibility of a class A fire in ordinary combustibles such as charts and logbooks on the navigation table.

2. Confining the Fire

The fire boundaries are the superstructure on the 03 Deck forward and aft, port and starboard, and the 03 Deck. The contents of the pyrotechnics locker, frame 30, starboard side on the 03 Weather Deck should be relocated aft on the 01 Weather Deck. In addition, the batteries that may be on charge in the battery case located on the starboard side of the 03 Weather Deck, frame 30, should also be relocated aft on the 01 Weather Deck.

3. Sizeup

The Bridge is continuously manned underway and frequently occupied in port. Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress to weather, there is little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO_2 portable fire extinguisher on class C fires and a PKP portable extinguisher on Class A fires.

5. Indirect Attack.

Fires in the Pilothouse may be indirectly attacked through a Pilothouse window. Use a 1.5" fire hose equipped with a vari nozzle to cool the superstructure and other fire boundaries as needed.

6. Direct Attack

Class C fires in this space should be attacked by securing the electrical power to the affected equipment first and then attacking the remaining class A fire directly (charged capacitors in electronic equipment may retain a significant electrical charge after power is secured). The #1 firefighting hose team should enter the Bridge through the windward weathertight door on the port or starboard side of the Pilothouse from the 03 Weather

Deck, with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter through the aft weathertight door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The Emergency Generator shall be started and placed in stand-by as a potential source of electrical power. The electrician should secure electrical power with the exception of lighting to the Pilothouse.

B. Upper Deck Utility Space No. 1, 02A-14-0-Q

1. Scenario

The Upper Deck Utility Space No.1, 02A-14-0-Q, shown on Figure C.6, is the space above the dropped celotex ceiling panels on the 02 Deck that encompasses all compartments on this deck with the exception of the Ship's Office, Fan Room, and Uptakes. Since many of the plywood joiner panels that partition the compartments on the Main Deck and above do not extend to the deck above, large void spaces are created which contain ductwork, piping, electrical cabling and insulation. The most likely fire in this space is a class A fire in the insulation that covers the ductwork and piping in this space.

2. Confining the Fire

The fire boundaries are the superstructure on the 02 Deck forward and aft, port and starboard, and the 02 and 03 Decks. The contents of the pyrotechnics locker, frame 30, starboard side on the 03 Weather Deck should be relocated aft on the 01 Weather Deck. In addition, the batteries that may be on charge in the battery case located on the starboard side of the 03 Weather Deck, frame 30, should also be relocated aft on the 01 Weather Deck. If time permits, the contents of the paint lockers located on the port side of the 02 Deck, frame 44, should be relocated aft on the 01 Weather Deck. The gasoline stowed on the starboard side of the 02 Deck, frame 64, should be jettisoned over the side if necessary.

3. Sizeup

The utility spaces are not manned, however the staterooms directly below the celotex dropped ceiling panels are likely to be occupied, possibly by sleeping crewmembers. The first priority should be to immediately investigate and evacuate all personnel from all staterooms and the Ship's Office on the 02 Deck. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher.

5. Indirect Attack

Due to the nature of these utility spaces, an indirect attack is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the 03 Deck and other fire boundaries as needed. Use a 1.5" hose equipped with a vari nozzle to cool the paint lockers (if relocating their contents is not feasible).

6. Direct Attack

When the scene leader directs, the #1 firefighting hose team should enter the 02 Deck Passageway from the 02 Weather Deck through the windward weathertight door, and remove ceiling panels as necessary to investigate and locate the fire. The scene leader may direct the use of the NFTI to locate the seat of a smoldering fire. The #1 firefighting hose team should use a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and an OBA. The #1 and #2 hose tenders should also wear an OBA.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator, wearing an OBA, shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed in standby as a potential source of electrical power.

C. Crew's Stateroom (3), 1-54-2-L

1. Scenario

The most likely fire in a stateroom is a class A fire in bedding materials.

2. Confining the Fire

The utility spaces above staterooms and other compartments on the Main Deck and above encompass numerous compartments on these decks as shown on Figures C.4 - C.6. Therefore, confining the fire to a particular compartment in the superstructure is difficult. The fire boundaries for Main Deck staterooms include the superstructure, the Main Deck and the 01 Deck. In addition, frames 6, 14, 34, 72 and the longitudinal centerline bulkhead between frames 34 and 72 extend to the 01 Deck, thus they may serve as fire boundaries if a smoke curtain is installed in the open doorway at frame 34 in the Main Deck Passageway. Therefore, the fire boundaries for stateroom 1-54-2-L, are frame 34 (the smoke curtain at frame 34 will only serve as a smoke boundary), the longitudinal centerline bulkhead, the superstructure on the port side and aft, the Main Deck and the 01 Deck.

3. Sizeup

Due to the likelihood of sleeping crewmembers in staterooms on the port side of the Main Deck Passageway there is a strong possibility that personnel may need to be rescued. It is assumed that EEBDs will be provided for all staterooms. The first priority should be to immediately investigate and evacuate all personnel from all staterooms on the port side of the Main Deck Passageway. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher.

5. Indirect Attack

Due to the inability to completely isolate the compartments in the superstructure an indirect attack is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the Main Deck and 01 Deck and other fire boundaries as needed.

6. Direct Attack

The #1 firefighting hose team should enter Stateroom 1-54-2-L through the joiner door from the Main Deck Passageway with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter through the same joiner door from the Main Deck Passageway with a 1.5" fire hose equipped with a vari nozzle set to the water fog position.

Alternatively, the #2 hose team may be directed to enter Stateroom 1-54-2-L from Stateroom 1-58-2-L through the shared sanitary space. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter Stateroom 1-54-2-L.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed in standby as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the staterooms on the port side of the Main Deck Passageway.

D. Toilet/Shower 02-27-2-L

1. Scenario

The sanitary spaces that serve the staterooms on this ship are constructed entirely of fiberglass. Therefore the most likely fire in this (or any other) Toilet/Shower is a class A fire in the fiberglass construction material. Toilet/Shower 02-27-2-L is the dedicated sanitary space for the Operations Officer's Stateroom, 02-22-2-L.

2. Confining the Fire

The utility spaces above staterooms and other compartments on the Main Deck and above encompass numerous compartments on these decks as shown on Figures C.4 - C.6. Therefore, confining the fire to a particular compartment in the superstructure is difficult. The fire boundaries for 02 Deck staterooms and their associated sanitary spaces include the superstructure on the 02 Deck forward and aft, port and starboard, the 02 Deck and the 03 Deck.

3. Sizeup

Due to the likelihood of sleeping crewmembers in staterooms on the 02 Deck there is a strong possibility that personnel may need to be rescued. It is assumed that EEBDs will be provided for all staterooms. The first priority should be to immediately investigate and evacuate all personnel from all staterooms on the 02 Deck. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher.

5. Indirect Attack

Due to the inability to completely isolate the compartments in the superstructure an indirect attack is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the Main Deck and 01 Deck and other fire boundaries as needed.

6. Direct Attack

The #1 firefighting hose team should enter the Operations Officer's Stateroom, 02-22-2-L through the joiner door from the 02 Deck Passageway with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 hose team shall attack the fire in the toilet/shower space 02-27-2-L directly through the joiner door from the Operations Officer's Stateroom. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Operations Officer's Stateroom through the same joiner door from the 02 Deck Passageway with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter Stateroom 02-22-2-L.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed in standby as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the staterooms on the 02 Deck.

E. Fan Room 1-34-2-Q

1. Scenario

The most likely fire in this compartment is a class C fire in an electrical motor associated with the ventilation fans in this space. There is also a significant possibility of a class A fire in conjunction with the class C fire due to the quantity of insulation associated with the ventilation ductwork in this space.

2. Confining the Fire

The utility spaces above staterooms and other compartments on the Main Deck and above encompass numerous compartments on these decks as shown on Figures C.4 - C.6. Therefore, confining the fire to a particular compartment in the superstructure is difficult. The fire boundaries for Main Deck compartments include the superstructure, the Main Deck and the 01 Deck. In addition, frames 6, 14, 34, 72 and the longitudinal centerline bulkhead between frames 34 and 72 extend to the 01 Deck, thus they may serve as fire boundaries if a smoke curtain is installed in the open doorway at frame 34 in the Main Deck Passageway. The bulkheads for the Fan Room 1-34-2-Q extend to the 01 Deck, therefore it may be possible to contain the fire to this compartment. Therefore, the secondary fire boundaries for Fan Room, 1-34-2-Q, are frame 34, the longitudinal centerline bulkhead, the superstructure on the port side and aft, the Main Deck and the 01 Deck.

3. Sizeup

Due to the likelihood of sleeping crewmembers in staterooms on the port side of the Main Deck Passageway there is a strong possibility that personnel may need to be rescued. It is assumed that EEBDs will be provided for all staterooms. The first priority should be to immediately investigate and evacuate all personnel from all staterooms on the port side of the Main Deck Passageway. The Fan Room is not normally occupied. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO2 portable fire extinguisher on Class C fires and a PKP portable extinguisher on Class A fires.

5. Indirect Attack

Due to the inability to completely isolate the compartments in the superstructure an indirect attack is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the Main Deck and 01 Deck and other fire boundaries as needed.

6. Direct Attack

The #1 firefighting hose team should enter Fan Room, 1-34-2-Q, through the joiner door from the Main Deck Passageway with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter through the same joiner door from the Main Deck Passageway with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not

enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter Fan Room, 1-34-2-Q.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed in standby as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the Fan Room 1-34-2-Q and all staterooms on the port side of the Main Deck Passageway.

F. Emergency Switchboard and Generator Room

1. Scenario

The most likely fire in this compartment is a class B spray fire due to a ruptured fuel oil or lube oil high pressure line in the emergency diesel engine. There is a significant possibility of a class A fire in ordinary combustibles such as the packing materials for spare parts stowed in this compartment. There is also a significant possibility of a class C fire in the emergency diesel generator or associated switchboard in this space.

2. Confining the Fire

The fire boundaries are bulkhead 6 forward, bulkhead 12 aft, the 01 Deck and 02 Deck.

3. Sizeup

The Emergency Switchboard and Generator Room is not normally manned. Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress forward and aft, there is little possibility that personnel may need to be rescued. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire. Class B fires are efficiently extinguished with PKP if the fire is small and 6% AFFF if the fire is larger. Note extinguishment of class B spray fires is not effective until the pressurized source of the fuel is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class A and B fires and a CO_2 portable extinguisher on Class C fires. The installed Halon 1301 system should not be activated until the pressurized source of fuel or lube oil is secured and the scene leader directs the use of the system.

5. Indirect Attack

If the compartment can be completely isolated (all doors, hatches, ventilation closures secured), a class A, B or C fire may be indirectly attacked with minimal risk to personnel by:

- securing the emergency generator,
- securing the ventilation fans,
- evacuating the space,
- securing electrical power to affected electrical equipment (class C fires) or securing the pressurized source of the flammable liquid spray fire (class B fires), and
- activating the installed Halon 1301 total flooding system. The system shall be activated only if the scene leader directs.

The scene leader and investigator shall monitor the effectiveness of the Halon 1301 by monitoring bulkhead temperatures and other appropriate means. The scene leader may direct re-entry in accordance with the direct attack procedures described in the next section after waiting a minimum of 15 minutes for the temperature to cool below the ignition point.

6. Direct Attack

For class B fires, or following activation of the installed Halon 1301 total flooding system, and when the scene leader directs, #1 firefighting hose team should enter the Emergency Switchboard and Generator Room from the 01 Deck Passageway through the aft watertight door in bulkhead 12 with a 1.5" fire hose configured to apply 6% AFFF. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Emergency Switchboard and Generator Room from the 01 Deck Passageway through the aft watertight door in bulkhead 12 with a 1.5" fire hose configured to apply 6% AFFF. The forward watertight door to the Emergency Switchboard and Generator Room shall be kept closed to prevent the spread of fire and smoke. The deck shall be blanketed with a minimum of 1/2 inch AFFF. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space. A class C fire shall be attacked directly, by first securing the source of electrical power, then attacking the remaining fire with PKP or CO_2 portable extinguishers. A class A fire shall be attacked directly with a 1.5" hose equipped with a vari nozzle set to the water fog position.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator, wearing an OBA, shall continually inspect the fire boundaries to ensure the fire has not spread. The P-250 shall be rigged on the weather deck as a backup source of firefighting water. The electrician should secure electrical power with the exception of lighting to the Emergency Switchboard and Generator Room

G. Bosun's Stores

1. Scenario

Forward of the Emergency Switchboard and Generator Room on the 01 Deck there are three storerooms. The Bosun's Stores and Storeroom No. 1 are partitioned by expanded metal bulkheads. Storeroom No. 2 has steel bulkheads. The most likely fire in the Bosun's Storeroom is a class A fire in the ordinary combustibles stowed in this space.

2. Confining the Fire

The fire boundaries are bulkhead 6 aft and the 01 and 02 Decks.

3. Sizeup

These spaces are not manned and there is little likelihood of trapped personnel. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher.

5. Indirect Attack

If the Bosun's Stores and Storeroom No. 1 can be completely isolated, the fire may be indirectly attacked with minimal risk to personnel by applying water fog from a 1.5" hose equipped with a vari nozzle through the emergency escape scuttle on the 02 Deck, frame 5, starboard side. If this attack is ineffective, or if the scene leader directs that a direct attack on the fire shall be attempted, the procedures in the next section for direct attack should be followed. Use a 1.5" fire hose equipped with a vari nozzle to cool the 02 Deck and other fire boundaries as needed.

6. Direct Attack

When the scene leader directs, the #1 firefighting hose team should enter Passageway 01-2-0-L, forward of the Emergency Switchboard and Generator Room through the watertight door in bulkhead 12 on the centerline with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and an OBA. The #1 and #2 hose tenders should also wear an OBA.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator, wearing an OBA, shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed in stand-by as a backup source of electrical power.

H. Hydraulic Power Room

1. Scenario

The most likely fire in this compartment is a class B spray fire due to a ruptured hydraulic oil line in this space.

2. Confining the Fire

The fire boundaries are bulkhead 68 forward, the 01 Deck superstructure aft and starboard, the 01 Deck and 02 Deck. Class B flammable liquid fires from pressurized sources are extremely difficult to extinguish unless the pressurized source of fuel can be secured. Potential sources of pressurized flammable liquids in the Hydraulic Power Room include hydraulic oil in the high pressure piping.

3. Sizeup

The Hydraulic Power Room is not normally manned. Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress forward into the Training Room/Crews Lounge, there is little possibility that personnel may need to be rescued. Class B fires are efficiently extinguished with PKP if the fire is small and 6% AFFF or Halon 1301 if the fire is larger. Note extinguishment of class B spray fires is not effective until the pressurized source of the fuel is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class B fires which are not fed by a pressurized fuel source. The installed Halon 1301 system should not be activated until the pressurized source of fuel or lube oil is secured and the scene leader directs the use of the system.

5. Indirect Attack

The Hydraulic Power Room, 01-69-1 Q, and the Electronics and Electrical Shop, 01-68-0-Q are protected by the same Halon 1301 total flooding system. Therefore, both spaces have to be completely isolated to prevent loss of agent and both spaces will be flooded when the system is activated. If these compartments can be completely isolated (all doors, hatches, ventilation closures secured), a class B fire may be indirectly attacked with minimal risk to personnel by:

- securing the ventilation fans,
- evacuating the spaces,
- securing the pressurized source of the flammable liquid spray fire and
- activating the installed Halon 1301 total flooding system. The system shall be activated only if the scene leader directs.

The scene leader and investigator shall monitor the effectiveness of the Halon 1301 by monitoring bulkhead temperatures and other appropriate means. The scene leader may direct re-entry in accordance with the direct attack procedures described in the next section after waiting a minimum of 15 minutes for the temperature to cool below the ignition point.

6. Direct Attack

For class B fires, or following activation of the installed Halon 1301 total flooding system, and when the scene leader directs, #1 firefighting hose team should enter the Hydraulic Power Room from the Training Room/Crews Lounge through the joiner door in bulkhead 68, starboard side with a 1.5" fire hose configured to apply 6% AFFF. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Hydraulic Power Room from the Training Room/Crews Lounge through the joiner door in bulkhead 68, starboard side with a 1.5" fire hose configured to apply 6% AFFF. The deck shall be blanketed with a minimum of 1/2 inch AFFF. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency diesel generator shall be started and placed in standby as a backup source of electrical power. The electrician should secure electrical power to the Hydraulic Power Room.

I. Electronics and Electrical Shop

1. Scenario

The most likely fire in this compartment is a class C fire in energized electronic or electrical equipment. There is also a significant possibility of a class A fire in ordinary combustibles such as technical manuals in this compartment.

2. Confining the Fire

The fire boundaries are bulkhead 68 forward, the 01 Deck superstructure aft and starboard, the 01 Deck and 02 Deck. The contents of the Deck Gear Locker, frame 73, starboard side on the 01 Weather Deck should be relocated to the Main Weather Deck aft.

3. Sizeup

The Electronics and Electrical Shop is not normally manned. Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress forward into the 01 Deck Passageway, 01-61-2-Land aft to the 01 Weather Deck, there is little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO_2 portable fire extinguisher on class C fires and a PKP portable extinguisher on Class A fires.

5. Indirect Attack.

The Hydraulic Power Room, 01-69-1 Q, and the Electronics and Electrical Shop, 01-68-0-Q are protected by the same Halon 1301 total flooding system. Therefore, both spaces have to be completely isolated to prevent loss of agent and both spaces will be flooded when the system is activated. If these compartments can be completely isolated (all doors, hatches, ventilation closures secured), a class A or class C fire may be indirectly attacked with minimal risk to personnel by:

- securing the ventilation fans,
- evacuating the spaces,
- securing the electrical power to the affected equipment and

- activating the installed Halon 1301 total flooding system. The system shall be activated only if the scene leader directs.

The scene leader and investigator shall monitor the effectiveness of the Halon 1301 by monitoring bulkhead temperatures and other appropriate means. The scene leader may direct re-entry in accordance with the direct attack procedures described in the next section after waiting a minimum of 15 minutes for the temperature to cool below the ignition point.

6. Direct Attack

Class C fires in this space should be attacked by securing the electrical power to the affected equipment first and then attacking the remaining class A fire directly (charged capacitors in electronic equipment may retain a significant electrical charge after power is secured). The #1 firefighting hose team should enter the Electronics and Electrical Shop from the 01 Weather Deck through the weathertight door in bulkhead 73, port side with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Electronics and Electrical Shop from the 01 Weather Deck through the weathertight door in bulkhead 73, port side with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

Following activation of the installed Halon 1301 total flooding system, and when the scene leader directs, #1 firefighting hose team should enter the Electronics and Electrical Shop from the 01 Weather Deck through the weathertight door in bulkhead 73, port side with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Electronics and Electrical Shop from the 01 Weather Deck through the weathertight door in bulkhead 73, port side with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space. Use a 1.5" fire hose equipped with a vari nozzle to cool the superstructure and other fire boundaries as needed.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The Emergency Generator shall be started and left in stand-by as a potential source of electrical power. The

electrician should secure electrical power with the exception of lighting to the Electronics and Electrical Shop.

J. Steward Storeroom

1. Scenario

The most likely fire in this compartment is a class A fire in ordinary combustibles stowed in this space.

2. Confining the Fire

The fire boundaries are bulkhead 6 aft, the Main Deck and 01 Deck.

3. Sizeup

This is an unmanned space, thus there is little possibility that personnel may need to be rescued. Class A combustibles are best extinguished by water fog Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class A fires.

5. Indirect Attack

The Steward Storeroom is accessible only from Storeroom No. 1 through a large grating constructed of expanded metal and down a vertical ladder. If the Bosun's Stores, Storeroom No. 1, and Steward Storeroom can be completely isolated, the fire may be indirectly attacked with minimal risk to personnel by applying water fog from a 1.5" hose equipped with a vari nozzle through the emergency escape scuttle on the 02 Deck, frame 5, starboard side. If this attack is ineffective, or if the scene leader directs that a direct attack on the fire shall be attempted, the procedures in the next section for direct attack should be followed. Use a 1.5" fire hose equipped with a vari nozzle to cool the 02 Deck and other fire boundaries as needed.

6. Direct Attack

When the scene leader directs, the #1 firefighting hose team should enter Passageway 01-2-0-L, forward of the Emergency Switchboard and Generator Room through the watertight door in bulkhead 12 on the centerline with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The fire should be attacked through the expanded metal grating on the deck of the Storeroom No.1 into the Steward Storeroom below. If directed by the scene leader, the #2 firefighting hose team should back up the first team with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and an OBA. The #1 and #2 hose tenders should also wear an OBA.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The Emergency Generator shall be started and left in stand-by as a backup source of electrical power. The electrician should secure electrical power, with the exception of lighting, to the following four storerooms forward of the Emergency Switchboard and Generator Room:

- Bosun's Stores, 01-G-0-A
- Storeroom No.1, 01-2-1-A
- Storeroom No.2, 01-1-2-A
- Steward Storeroom, 1-D-0-A

K. Communication Center

1. Scenario

The most likely fire in this compartment is a class C fire in electronic communications equipment stowed in racks.

2. Confining the Fire

The utility spaces above compartments on the Main Deck and above encompass numerous compartments on these decks as shown on Figures C.4 - C.6. Therefore, confining the fire to a particular compartment in the superstructure is difficult. The fire boundaries for 01 Deck compartments include the superstructure, the 01 Deck and the 02 Deck. In addition, frames 6, 12, 34, 54, 68 and the longitudinal centerline bulkhead between frames 14 and 68 extend to the 02 Deck, thus they may serve as fire boundaries if a smoke curtain is installed in the open doorway at frame 34 in the 01 Deck Passageway. Therefore, the fire boundaries for the Communication Center, 01-54-1-C, are bulkhead 54 forward and bulkhead 68 aft, the longitudinal centerline bulkhead (starboard side of the 01 Deck Passageway), and the 01 and 02 Decks.

3. Sizeup

Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress through the starboard weathertight door to the 01 Weather Deck or through the joiner door to the Vestibule, 01-54-2-l (and then either forward or aft), there is little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO_2 portable fire extinguisher on Class C fires and a PKP portable extinguisher on Class A fires.

5. Indirect Attack.

If the compartment can be completely isolated, an indirect attack can be attempted with minimal risk to personnel through the emergency escape scuttle on the starboard bulkhead of the compartment from the 01 Weather Deck. After securing electrical power to the Communication Center, insert a 1.5" hose fitted with a vari-nozzle set to water fog position through the emergency escape scuttle. If this attack is ineffective or if the scene leader directs, a direct attack should follow the procedures in the next section. Use a 1.5" fire hose equipped with a vari nozzle to cool the 02 Deck and other fire boundaries as needed.

6. Direct Attack

Class C fires in this space should be attacked by securing the electrical power to the affected equipment first and then attacking the remaining class A fire directly (charged capacitors in electronic equipment may retain a significant electrical charge after power is secured). The #1 firefighting hose team should enter the Communication Center from the 01 Weather Deck through the emergency escape scuttle in the starboard bulkhead with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Communication Center through the same door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The joiner door to the Communication Center from the Vestibule, 01-54-2-L should be kept closed to prevent fire and smoke from spreading to the interior of the ship. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The Emergency Generator shall be started and left in stand-by as a backup source of electrical power. The electrician should secure electrical power, with the exception of lighting, to the Communication Center.

L. Main Control Station

1. Scenario

The most likely fire in this compartment is a class C fire in the main propulsion control console or the main electrical distribution switchboard.

2. Confining the Fire

The fire boundaries are bulkhead 52 forward, bulkhead 60 aft, and the Main Deck.

3. Sizeup

This space is occupied continuously underway and frequently in port. Personnel in this space will be awake and alert and there is easy egress forward into the Main Generator Room or aft into the Main Propulsion Motor Room. Therefore there is little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class A fires and a CO_2 portable extinguisher on Class C fires.

5. Indirect Attack

Due to the configuration of the equipment and switchboards in this space an indirect attack is not feasible. When the scene leader directs, follow the procedures for a direct attack in the next section. Use a 1.5" fire hose equipped with a vari nozzle to cool the Main Deck and other fire boundaries as needed.

6. Direct Attack

Class C fires in this space should be attacked by securing the electrical power to the affected equipment first and then attacking the remaining class A fire directly (charged capacitors in electronic equipment may retain a significant electrical charge after power is secured). The #1 firefighting hose team should enter the Main Control Station from the Main Generator Room through the joiner door in the forward bulkhead with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Main Control Station from the Propulsion Motor Room through the joiner door on the port side of the aft bulkhead with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The Emergency Generator shall be started and left in stand-by as a backup source of electrical power. The electrician should secure electrical power, with the exception of lighting, to the Main Control Station.

M. Propulsion Motor Room

1. Scenario

The most likely fire in this compartment is a class C fire in one of the main propulsion motors.

2. Confining the Fire

The Propulsion Motor Room spans two levels (2nd and 3rd Decks). The fire boundaries are bulkhead 52 (2nd Deck) and 60 (3rd Deck) forward, bulkhead 72 aft, and the Main Deck. The watertight door to the Tunnel aft on the lower level and the Main Control Station forward on the upper level should not be opened to prevent the possible spread of fire and smoke.

3. Sizeup

Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress forward, aft, and upward there is little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO_2 portable fire extinguisher on Class C fires and a PKP portable extinguisher on Class A fires. Neither the installed Halon 1301 system or the installed CO_2 main motor flooding systems should be activated unless higher authority such as the Commanding Officer, Engineering Officer of the Watch, or scene leader directs the use of one of the systems.

5. Indirect Attack

If the compartment can be completely isolated (all doors, hatches, ventilation closures secured), a class C fire may be indirectly attacked with minimal risk to personnel by:

- securing the power to the affected main motor,
- securing the ventilation fans in the Motor Room,
- evacuating the space,
- activating the installed CO_2 system for the affected motor or the Halon 1301 total flooding system in the event of a fire in the Propulsion Motor Room that does not necessarily involve one of the main motors, from the remote release station in the Main Control Station, 2-52-0-C, (not locally). Neither system shall be activated unless the scene leader directs.

The scene leader and investigator shall monitor the effectiveness of the Halon 1301 or CO_2 by monitoring bulkhead temperatures and other appropriate means. If either system is used the scene leader may direct re-entry in accordance with the direct attack procedures described in the next section after waiting a minimum of 15 minutes for the temperature to cool below the ignition point.

6. Direct Attack

Following activation of one of the installed CO_2 main motor flooding systems or the Halon 1301 total flooding system to combat a class C fire, and when the scene leader directs, #1 firefighting hose team should enter the Propulsion Motor Room from the Main Deck Passageway through the joiner door on the starboard side of the Main Deck Passageway, frame 68, and down the inclined ladder with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Propulsion Motor Room from the Main Deck Passageway through the joiner door frame 68 with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The forward watertight door to the Main Control Station and the aft watertight door leading to the Tunnel should be kept closed to prevent the spread of fire and smoke. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The Emergency Generator

shall be started and placed in stand-by as a backup source of electrical power. The electrician should secure electrical power, with the exception of lighting, to the Propulsion Motor Room

N. Main Generator Room

1. Scenario

The most likely fire in this compartment is a class B spray fire due to a ruptured lube oil or fuel oil line on a main diesel engine. There is also a significant possibility of a class C fire in one of the main diesel generators, or one of the motors or controllers or other electrical equipment in the Engine Room.

2. Confining the Fire

The fire boundaries are bulkhead 34 forward, bulkhead 52 aft, and the Main Deck. The supply and exhaust fans that serve the Main Generator Room shall be secured and all four main diesel generators shall be secured. The stack dampers on the 03 deck shall be secured. The remote fuel shutoffs for the main diesel generators, located in the Main Deck Passageway frames 63-69, shall also be secured.

3. Sizeup

The Main Generator Room is normally unmanned, and the ease of egress forward, upward and aft make it unlikely that personnel will need to be rescued. Class B flammable liquid fires are effectively extinguished by 6% AFFF. If the space can be completely isolated to prevent the loss of agent, Halon 1301 is also effective against a class B fire. Experience has shown that flammable liquid spray fires are extremely difficult to extinguish unless the pressurized source of fuel can be secured. This space is protected with an installed Halon 1301 total flooding fire extinguishing system.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on a class B fire and a CO_2 portable extinguisher on a class C fire. As noted above, highest priority should be given to securing pressurized sources of fuel.

5. Indirect Attack

If the compartment can be completely isolated (all doors, hatches, ventilation closures secured), a class B fire may be indirectly attacked with minimal risk to personnel by:

- securing the main diesel generators,
- securing the stack dampers,
- securing the ventilation fans,
- evacuating the space,

- securing the pressurized source of the flammable liquid spray fire (class B fires) by securing the remote fuel shutoffs, and
- activating the installed Halon 1301 total flooding system when the scene leader directs.

The scene leader and investigator shall monitor the effectiveness of the Halon 1301 by monitoring bulkhead temperatures and other appropriate means. The scene leader may direct re-entry in accordance with the direct attack procedures described in the next section after waiting a minimum of 15 minutes for the temperature to cool below the ignition point.

6. Direct Attack

For class B fires or following activation of the installed Halon 1301 total flooding system, and when the scene leader directs, #1 firefighting hose team should enter the Main Generator Room from the Main Deck Passageway through the joiner door on the starboard side, frame 48, and down the inclined ladder with a 1.5" fire hose configured to apply 6% AFFF. If the scene leader directs, the #2 firefighting hose team should back up the first team and enter the Main Generator Room from the Main Deck Passageway through the joiner door on the starboard side, frame 48, and down the inclined ladder with a 1.5" fire hose configured to apply 6% AFFF. The watertight door forward to the Passageway and the watertight door aft to the Main Control Station shall be kept closed to prevent the spread of fire and smoke. The bilges shall be blanketed with a minimum of 1/2 inch AFFF. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA. Operate the supply and exhaust fans on high for at least 15 minutes after the Main Generator Room atmosphere has been tested and proven free of flammable gases.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as the source of electrical power. The electrician should secure electrical power with the exception of lighting to the Main Generator Room.

O. Bow Thruster Electric Motor Room

1. Scenario

The most likely fire in this compartment is a class C fire in the electric controller or bow thruster motor. A class B fire is also likely in the grease and oil associated with the

bow thruster motor and drive train to the propeller located in an enclosed tunnel below the space.

2. Confining the Fire

The fire boundaries are Bulkhead 6 forward and bulkhead 12 aft, and the Main Deck. Note Fuel Tanks 4-12-0-F, 4-12-1-F and 4-12-2-F are located on the after side of Bulkhead 12. There is no cofferdam. Therefore, unless these tanks are empty and gas freed, they shall be immediately pressed up.

3. Sizeup

This space is not manned, and there is very little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire. Class B fires are effectively extinguished with 6% AFFF. This space is also protected by an installed Halon 1301 total flooding system.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO_2 portable fire extinguisher on Class C fires and a PKP portable extinguisher on Class A fires.

5. Indirect Attack.

If the space can be completely isolated and the electrical power to affected machinery can be secured, a class B or class C fire in the Bow Thruster Electric Motor Room can be attacked indirectly with minimal danger to personnel by activating the installed Halon 1301 total flooding system. When the scene leader directs, re-entry procedures should be in accordance with the direct attack procedures in the next section. Use a 1.5" fire hose equipped with a vari nozzle to cool the Main Deck and other fire boundaries as needed.

6. Direct Attack

For class B fires or following activation of the installed Halon 1301 total flooding system and when the scene leader directs, the #1 firefighting hose team should open the watertight hatch in the Main Deck Passageway that provides access to the Bow Thruster Electric Motor Room. The #1 hose team shall use a 1.5" fire hose equipped with a vari nozzle set to the water fog position and combat the fire from the Main Deck through the open hatch. If directed by the scene leader, the #2 firefighting hose team should back up the first team through the same watertight hatch with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as the source of electrical power. The electrician should secure electrical power with the exception of lighting to the Bow Thruster Electric Motor Room.

P. A/C Machinery Space

1. Scenario

The most likely fire in this compartment is a class C fire in one of the electrical motors in this space. There is also a significant possibility of a class A fire in the insulation used extensively in this space.

2. Confining the Fire

The fire boundaries are bulkhead 24 forward and bulkhead 34 aft, and the Main Deck.

3. Sizeup

This space is unmanned and there is little possibility that personnel may need to be rescued. Class C fires are effectively extinguished with CO_2, however it is imperative that electrical power to the affected energized equipment is secured first. A class A fire may be burning in conjunction with the equipment that was the cause of the class C fire class A fires are effectively extinguished with water fog or with a portable PKP if the fire is small.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a CO_2 portable fire extinguisher on class C fires and a PKP portable extinguisher on Class A fires.

5. Indirect Attack.

Since there is no installed firefighting system and due to the configuration of the compartmentation in this part of the cutter an indirect attack is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the fire boundaries as needed.

6. Direct Attack

Class C fires in this space should be attacked by securing the electrical power to the affected equipment first and then attacking the remaining class A fire directly (charged capacitors in electronic equipment may retain a significant electrical charge after power is secured). The #1 firefighting hose team should enter the A/C Machinery Space through the watertight door from the Passageway forward of the Main Generator Room with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and use the same attack route with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the A/C Machinery Space.

Q. Steering Gear Room

1. Scenario

The most likely fire in this compartment is a class B fire in the steering gear equipment in this compartment.

2. Confining the Fire

The fire boundaries are bulkhead 94 forward and the Main Deck.

3. Sizeup

This is an unmanned space, thus there is little possibility that personnel may need to be rescued. Class B flammable liquid fires are effectively extinguished by 6% AFFF. Experience has shown that flammable liquid <u>spray</u> fires are extremely difficult to extinguish unless the pressurized source of fuel can be secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class B fires.

5. Indirect Attack

If the compartment can be completely isolated the fire may be indirectly attacked with minimal risk to personnel by applying 6% AFFF from a 1.5" hose equipped with a vari nozzle through the hatch on the port side of the Main Deck. If this attack is ineffective or if the scene leader directs follow the procedures for a direct attack in the next section. Use a 1.5" fire hose equipped with a vari nozzle to cool the Main Deck and other fire boundaries as needed.

6. Direct Attack

A direct attack on Class B fires in this spaces is not recommended, however if the scene leader directs the preferred access to the compartment is from the Tunnel through the watertight door into the Steering Gear Room. The #1 firefighting hose team should enter the Steering Gear Room with a 1.5" fire hose equipped with a vari nozzle configured to apply 6% AFFF against a class B fire. If the scene leader directs, the #2 firefighting hose team should back up the first team and enter the Steering Gear Room following the same attack route as the first team with a 1.5" fire hose equipped with a vari nozzle configured to apply 6% AFFF. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the Steering Gear Room.

R. Galley

1. Scenario

The most likely fire in this compartment is a class B grease fire in the galley on the stove. There is also a significant possibility of a class C fire in the electrical equipment in the Galley such as the microwave oven, refrigerator/freezer or mixer.

2. Confining the Fire

The utility spaces above compartments on the Main Deck and above encompass numerous compartments on these decks as shown on Figures C.4 - C.6. Therefore, confining the fire to a particular compartment in the superstructure is difficult. The fire boundaries for Main Deck compartments include the superstructure, the Main Deck and the 01 Deck. In addition, frames 6, 14, 34, 72 and the longitudinal centerline bulkhead between frames 34 and 72 extend to the 01 Deck, thus they may serve as fire boundaries if a smoke curtain is installed in the open doorway at frame 34 in the Main Deck Passageway. The bulkheads for the Galley, 1-42-1-Q extend to the 01 Deck, therefore it may be possible to contain the fire to this compartment. Therefore, the secondary boundaries for the Galley are frames 34, and 72, the longitudinal centerline bulkhead, the superstructure on the starboard side and aft, the Main Deck and the 01 Deck.

3. Sizeup

Due to the likelihood that crewmembers in this space are awake and alert, and the ease of egress forward and aft, there is little possibility that personnel may need to be rescued. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire. Class B fires are efficiently extinguished with PKP if the fire is small and 6% AFFF if the fire is larger. The installed aqueous potassium carbonate system is also effective against a class B grease fire on the galley stove.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class B fires and a CO_2 portable extinguisher on Class C fires. The installed aqueous potassium carbonate system should be immediately activated in the event of a grease fire on the galley stove.

5. Indirect Attack

A grease fire on the galley stove can be effectively extinguished by activating the installed aqueous potassium carbonate fire extinguishing system. Since there is no installed fixed firefighting system and due to the configuration of the compartmentation in this part of the cutter, an indirect attack on class A and class C fires in these spaces is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the fire boundaries as needed.

6. Direct Attack

When directed by the scene leader and after securing electrical power to affected equipment, the #1 firefighting hose team should enter the Galley from the Main Deck Passageway through the joiner door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Galley from the Wardroom or the Crews Mess Room depending on the location of the fire with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in

FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space. The other door serving the Galley should not be opened until the fire is completely out and the atmosphere tested safe. Class B fires not extinguished by the installed aqueous potassium carbonate system should be attacked directly with PKP portable extinguishers if the fire is small and confined to the stove area in the galley. If the class B fire has spread, the fire should be attacked directly with water fog or preferably 6% AFFF. Class C fires should be extinguished with a portable CO_2 extinguisher after the electrical power to the affected equipment is secured.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator, wearing an OBA, shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the Galley.

S. Scullery

1. Scenario

The most likely fire in this compartment is a class A fire in ordinary combustibles in this space.

2. Confining the Fire

The utility spaces above compartments on the Main Deck and above encompass numerous compartments on these decks as shown on Figures C.4 - C.6. Therefore, confining the fire to a particular compartment in the superstructure is difficult. The fire boundaries for Main Deck compartments include the superstructure, the Main Deck and the 01 Deck. In addition, frames 6, 14, 34, 72 and the longitudinal centerline bulkhead between frames 34 and 72 extend to the 01 Deck, thus they may serve as fire boundaries if a smoke curtain is installed in the open doorway at frame 34 in the Main Deck Passageway. The fire boundaries for the Scullery, 1-4--2-Q are frames 34, and 72, the longitudinal centerline bulkhead, the superstructure on the port side and aft, the Main Deck and the 01 Deck..

3. Sizeup

This is an unmanned space, thus there is little possibility that personnel may need to be rescued. Class A combustibles are best extinguished by water fog Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is

minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class A fires.

5. Indirect Attack

Since there is no installed fixed firefighting system and due to the configuration of the compartmentation in this part of the cutter, an indirect attack on class A and class C fires in these spaces is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the fire boundaries as needed.

6. Direct Attack

When directed by the scene leader, the #1 firefighting hose team should enter the Scullery from the Main Deck Passageway through the joiner door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Scullery from the Main Deck Passageway through the joiner door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the Scullery.

T. Uptake

1. Scenario

The most likely fire in this compartment is a combination class A/B fire in lube oil soaked insulation on the exhaust pipes in the stack/uptake.

2. Confining the Fire

The fire boundaries are the Stack boundaries. All engines exhausting through the affected stack and uptake should be immediately secured. The other stack will be needed

to ensure the cutter can maneuver and produce electrical power for the fire pumps. Therefore ventilation should only be secured in the affected stack/uptake. Do not secure the stack dampers since an indirect attack may be made through the louvers.

3. Sizeup

The Main Generator Room in this cutter is normally unmanned, and the ease of egress fore and aft make it unlikely that personnel will need to be rescued. Class B combustibles are best extinguished by AFFF or water fog. Class A fires are best extinguished with water.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on a class A or B fire.

5. Indirect Attack

A combination class A/B fire may be indirectly attacked with minimal risk to personnel by shutting down the main diesel generators, and ventilation fans; served by the affected stack; and attacking the fire through the ventilation louvers with AFFF or water fog. If the scene leader declares the fire to be out of control the fire should be attacked following the procedures for a class B fire in the Main Generator Room as discussed in paragraph III N above.

6. Direct Attack

When the scene leader directs, #1 firefighting hose team should approach the affected stack from the 03 Weather Deck and apply AFFF or water fog through the ventilation louvers. If directed by the scene leader, the #2 firefighting hose team should back up the first team and apply additional agent through the same louvers. The #1 and #2 nozzlemen should be dressed out in FFEs and should wear an OBA. The #1 and #2 hose tenders should also wear an OBA. The installed Halon 1301 total flooding system serving the Main Generator Room may be effective depending on the nature and location of the fire. If the scene leader directs, follow the procedures described in paragraph III N above for activation of the Halon 1301 system.

7. Post-fire Activities

Conduct atmospheric testing for oxygen and toxic gas levels before entering the Engine Room without an OBA. Operate the supply and exhaust fans on high for at least 15 minutes after the Main Generator Room atmosphere has been tested and proven free of flammable gases.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power to the Main Generator Room.

U. Laundry Room

1. Scenario

The most likely fire in this compartment is a class A fire in clothing or the lint buildup in the dryers. There is also a significant possibility of a class B fire in the various 5 gallon cans of flammable liquids stored in this space. There is also a significant possibility of a class C fire in the electric clothes dryers installed in the Laundry.

2. Confining the Fire

The fire boundaries are bulkhead 24 forward, bulkhead 34 aft, and the Main Deck. Note Fuel Tanks 4-12-1-F and 4-18-0-F are located on the forward side of Bulkhead 24. There is no cofferdam. Therefore, unless these tanks are empty and gas freed, they shall be immediately pressed up.

3. Sizeup

This compartment is not normally manned, therefore there is little possibility that personnel may need to be rescued. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured. Class C fires are usually extinguished when electrical power is secured, however a class A fire may be burning in conjunction with the equipment that was the cause of the class C fire. Class B fires are efficiently extinguished with PKP if the fire is small and 6% AFFF if the fire is larger.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class A and B fires and a CO_2 portable extinguisher on Class C fires.

5. Indirect Attack

Since there is no installed fixed firefighting system and due to the configuration of the compartmentation in this part of the cutter, an indirect attack on fires in the Laundry is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the fire boundaries as needed.

6. Direct Attack

When directed by the scene leader; the #1 firefighting hose team should enter the Laundry from the Passageway forward of the Main Generator Room through the joiner door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position for class A or class C fires; 6% AFFF shall be used for class B fires. If directed by the scene leader, the #2 firefighting hose team should back up the first team and enter the Laundry through the same door with a 1.5" fire hose equipped with a vari nozzle set to the water fog position for class A or class C fires; 6% AFFF shall be used for class B fires. The #1

and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space. The watertight door to the Main Generator Room in bulkhead 34 should not be opened until the fire is completely out and the atmosphere tested safe. Class C fires should be extinguished with a portable CO_2 extinguisher after the electrical power to the affected equipment is secured.

7. Post-fire Activities

Smoldering materials should be jettisoned overboard, with the Commanding Officer's permission, or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator, wearing an OBA, shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power to the Laundry.

V. Tunnel

1. Scenario

The most likely fire in this compartment is a class B fire in the flammable liquids stowed in this compartment.

2. Confining the Fire

The fire boundaries are bulkhead 72 forward, bulkhead 94 aft, and the Main Deck. Fuel Oil Tanks 4-72-1-F and 4-72-2-F are on the port and starboard sides of the forward segment of the Tunnel. There is no cofferdam. Therefore, unless these tanks are empty and gas freed, they shall be immediately pressed up.

3. Sizeup

The Tunnel is normally unmanned, therefore it is unlikely that personnel will need to be rescued. Class B flammable liquids are efficiently extinguished by 6% AFFF.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on a class B fire.

5. Indirect Attack

Since there is no installed fixed firefighting system and due to the configuration of the compartmentation in this part of the cutter, an indirect attack on fires in the Tunnel is not feasible. Use a 1.5" fire hose equipped with a vari nozzle to cool the fire boundaries as needed.

6. Direct Attack

When the scene leader directs, #1 firefighting hose team should enter the Tunnel from the Main Propulsion Motor Room through the watertight door in bulkhead 72 with a 1.5" fire hose configured to apply 6% AFFF. If directed by the scene leader, the #2 firefighting hose team should back up the first team through the same door with a 1.5" fire hose configured to apply AFFF. The bilges shall be blanketed with a minimum of 1/2 inch AFFF. The #1 and #2 nozzlemen should be dressed out in FFEs and should not enter the space without an OBA. The #1 and #2 hose tenders should wear an OBA but they should not enter the space.

7. Post-fire Activities

Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator, wearing an OBA, shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed on the line as a backup source of electrical power. The electrician should secure electrical power with the exception of lighting to the Tunnel.

W. In Port Fires

1. Scenario

The most likely fire in port is a class A fire in one of the Berthing Areas in bedding materials. A class B fire in the galley is the next most likely fire in port.

2. Confining the Fire

The fire boundaries are stated above and depend on the involved compartment.

3. Sizeup

Due to the likelihood of sleeping crewmembers, there is a strong possibility that personnel may need to be rescued. Class A combustibles are best extinguished by water fog. Deep-seated fires may require a solid stream for effective extinguishment. Note danger of electrocution is minimized with water fog due to the separation of the water particles; a solid stream should not be used unless electrical power (including lighting) is secured.

4. First Aid

If the fire is discovered when it is small enough to attempt first aid the person discovering the fire should use a PKP portable fire extinguisher on class A or B fires and a portable CO_2 extinguisher on class C fires.

5. Indirect Attack

An indirect or direct attack can only be attempted in the event the full in port duty section is on board to properly man a repair party, otherwise additional help will be required. This help can come from another Coast Guard Cutter, the Group or Station where the Cutter is berthed, or from the local fire department. An indirect attack may be attempted as described above for the particular compartment involved.

6. Direct Attack

A direct attack may be attempted if the scene leader directs in accordance with the procedures described above for the particular compartment involved.

7. Post-fire Activities

Smoldering materials should be jettisoned, with the Commanding Officer's permission, overboard or soaked in a bucket of water on the weather deck. Conduct atmospheric testing for oxygen and toxic gas levels before entering the space without an OBA.

8. Other Actions

During firefighting actions the investigator wearing an OBA shall continually inspect the fire boundaries to ensure the fire has not spread. The emergency generator shall be started and placed in standby as a backup source of electrical power. The P-250 shall be rigged as a backup source of firefighting water if the scene leader so directs. The electrician should secure electrical power with the exception of lighting to the affected space.